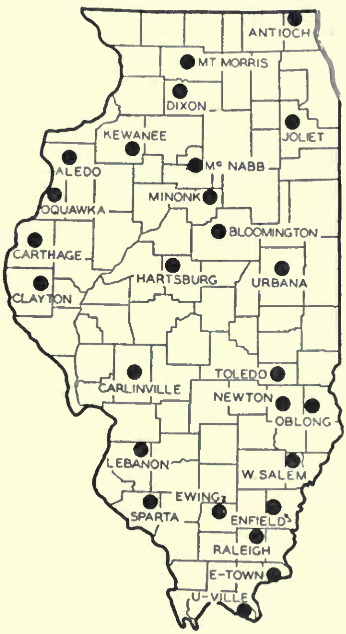
Crop Yields From Illinois Soil Experiment Fields in 1933

Together With a General Summary for the Four-Year Period Ending in 1933

By F. C. Bauer



Results from twenty-six fields are given in this bulletin

UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION
BULLETIN 402
(May, 1934)

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Urbana, Illinois May, 1934

Publications in the Bulletin series report the results of investigations made by or sponsored by the Experiment Station

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Together With a General Summary for the Four-Year Period Ending in 1933

By F. C. Bauer, Chief, Soil Experiment Fields

SOILS are somewhat like growing and aging human beings. Their ability to perform, that is to produce crops, and their requirements for producing crops are constantly changing. The rapidity with which these changes take place depends, in a broad sense, on the quality of the materials from which a soil is formed, on the intensity of the weathering forces acting on these materials, and on the care exercised in management and treatment. Frequently these influences tend to impoverish soils and thus reduce performance. A successful agriculture cannot be established on impoverished soils.

Soil management and treatment practices properly employed can do much to reduce variation in soil productivity and to uncover latent productivity that may exist. No single system of management or treatment, however, can be expected to give the best results on all soils, nor can a system that is effective on a particular soil at a particular time be expected to give the best results for all time to come. Systems of management and treatment must be adapted to the widely differing nature of soils and to their changing needs. Broadly speaking, farmers are interested in the simplest system of management that will give the most satisfactory results.

In order to test the effectiveness of different systems of soil treatment on the yields of farm crops, the Illinois Agricultural Experiment Station for a number of years has conducted field investigations in many sections of the state on extensive soil types differing widely in productiveness. Investigations along this line have been in progress at Urbana since 1876. The first of the present outlying soil experiment fields were established in the fall of 1901. Some of the original fields are still in operation; some have been discontinued at one time or another for various reasons. During the crop season of 1933 twenty-six fields were in operation.

Complete records from all the Illinois soil experiment fields up to and including 1924 were reported in Bulletin 273. Subsequent results have been reported annually in bulletin form. The present bulletin is a continuation of this series. In the earlier bulletins the crop yields were presented merely as a matter of record, without comment or discussion. In order, however, to give a better picture of the results as a whole, a general summary of the last rotation period on each field has been included in the more recent reports. In this bulletin a summary for the four-year period ending in 1933 is included as Part I. The crop yields for 1933 are presented in Part II.

The tables in Part II, in addition to giving the 1933 yields for each crop in each series under each treatment, record the average yields of *all* crops for each treatment system in terms of *pounds of digestible nutrients* and indicate the *ratio* between the yields produced under treatment and those grown under no treatment. By means of the average yield figures one can readily observe the influence of any particular soil treatment in terms of *all* crops; while the *ratio* figures give one a direct measure of the *relative importance* of the various treatment systems in comparison with no treatment, the yields from the untreated plots being placed at 1.000. If one is interested in *percentage increases,* he can readily determine them by subtracting 1.000 from any ratio figure and moving the decimal point two places to the right. Land left untreated as a check for the purpose of determining the value of the various treatment systems is provided by Plot 1 in the manure systems and Plot 5 in the residues systems.

An index to the yields obtained with different fertilizer and treatment materials is given on page 91.

Explanation of Symbols

The following symbols are used in the tables to denote the soil treatments applied:

0 = **No soil treatment.**

M = **Manure.** One ton for each ton of crops grown is usually applied once in four years for the corn crop.

R = **Crop residues.** Cornstalks, green-manure sweet clover, second-crop red clover, etc., are plowed into the soil.

L = **Limestone.** For most fields limestone has been applied in amounts equivalent to 700 to 800 pounds an acre annually. In the future, applications are to be made when the need for them appears

K = **Potash.** For many years kainit at the annual acre-rate of 200 pounds was used. Now muriate of potash is used at the rate of 100 pounds an acre for each corn and wheat crop.

KCl = **Muriate of potash.**

rP = **Rock phosphate.** For most fields rock phosphate has been applied in amounts equivalent to 350 to 400 pounds an acre annually.

sP = **Superphosphate.** Rates vary with the experiment. In general the rates approximate half the rock-phosphate rate.

bP = Bone phosphate. Applications are similar to those of superphosphate.

N = Nitrogen. The carrier and the rates of application vary with the experiment. Facts are given with the data.

( ) = Tons. To differentiate ton yields from bushel yields, the figures denoting tons are placed in parentheses.

Soil Groups Represented[1]

The results reported on pages 60 to 91 are for individual fields arranged alphabetically rather than by location or soil types. The general character of the soils represented by these fields is indicated by the following classification. The dates given indicate the years in which the various fields were established.

Group No.	*Description of Soil*	*Location of field*	*Year established*
1.	Dark soils with heavy, noncalcareous subsoils		
	Semimature	Bloomington	1902
	Young	Aledo	1910
		Hartsburg	1911
		Minonk	1910
2.	Dark soils with impervious, calcareous subsoils		
	Young (due to erosion)	Joliet	1914
3.	Dark soils with noncalcareous subsoils		
	Semimature	Urbana	1876
	Young	Kewanee	1915
4.	Dark soils with open, noncalcareous subsoils		
	Semimature	Dixon	1910
		Mt. Morris	1910
	Young	McNabb	1907
5.	Dark soils with impervious, noncalcareous subsoils		
	Semimature	Carthage	1911
		Clayton	1911
		Lebanon	1910
	Mature	Carlinville	1910
7.	Gray soils with impervious noncalcareous subsoils		
	Old (moderately well drained)	Ewing	1910
		Oblong	1912
	Old (poorly drained; slick spots numerous)	Newton	1912
		Raleigh	1910
		Toledo	1913
	Old (very poorly drained; slick spots numerous)	Sparta	1916
8.	Yellow soils with noncalcareous subsoils		
	Mature	Enfield	1912
		Unionville	1911
		West Salem	1912
11.	Brownish yellow soils with calcareous subsoils		
	Young	Antioch	1902
14.	Sandy loams and sands		
	Semimature	Oquawka	1915
16.	Hilly land		
	Mature	Elizabethtown	1917

[1]Classification prepared by R. S. Smith, Chief in Soil Physics and Soil Survey.

PART I. ROTATION SUMMARIES

THE SUMMARIES on the following pages indicating, mostly in terms of money values, the results from soil treatments on the Illinois soil experiment fields during the four-year period ending in 1933, give a clearer conception of the influence of the treatments than can be obtained by studying each field or each year independently. A very condensed form of summary is used. The crop yields for the four-year period have been averaged and converted to money values. These money values have in turn been reduced to an annual acre-basis. For those fields on which a four-year rotation is practiced and each crop is grown every year, an arrangement which prevails on most fields, this procedure condenses 16 crop yields into one figure. Such figures make it possible to see at a glance the relative advantage of any particular treatment for the four-year period.

The crop prices on which these figures are based are the after-harvest prices of crops on Illinois farms as reported by the federal government. Each year's crop yields were figured at the prices for that particular year before the average was computed. Averaging these prices for the four-year period ending in 1933 gives the following figures: *corn,* 38 cents; *oats,* 22 cents; *wheat,* 60 cents a bushel; *mixed hay,* $8.27; *clover hay,* $9.22 and *alfalfa,* $12.25 a ton.

Where deductions were made for the cost of treatment applied, *crop residues* were figured as costing 75 cents an acre annually, and *manure, limestone, rock phosphate,* and *kainit* at 75 cents, $3, $15, and $30 a ton respectively. Under average conditions these prices should cover the cost of application as well as purchase.

When studying experimental results such as these in terms of money values, one should keep in mind that the above crop prices are the lowest reported for many years. At such prices increases in yield may appear somewhat insignificant when in reality they are of considerable importance from the point of view of crop response to soil treatment and of soil improvement.

Variations in Natural Productivity Levels

Illinois soils vary greatly in their natural productivity. This is evident from the results obtained from the untreated land on the twenty-five soil experiment fields listed in Table 1. The annual acre-value of the crops grown during the last rotation ranged from $2.00 at Ewing to $21.42 at McNabb. Values for the other fields are distributed more or less regularly between these two extremes.

TABLE 1.—UNTREATED LAND: VALUE OF ALL CROPS GROWN ON UNTREATED LAND OF TWENTY-FIVE ILLINOIS SOIL EXPERIMENT FIELDS, AND PRODUCTIVITY LEVEL OF EACH FIELD EXPRESSED AS A PERCENTAGE OF THE AVERAGE PRODUCTIVITY LEVEL OF FIVE FIELDS HAVING GOOD PRODUCTIVE LEVELS[1]

(Values represent average annual acre-returns for the four-year period ending in 1933)

Rank	Field	County	Section of state	Value	Productivity level
Darker colored soils					*perct.*
1	McNabb	Putnam	NW	$21.42	134
2	Aledo	Mercer	NW	17.75	111
3	Dixon	Lee	NW	16.52	103
4	Kewanee	Henry	NW	16.40	102
5	Mt. Morris	Ogle	NW	15.08	95
6	Hartsburg	Logan	C	14.80	92
7	Minonk	Woodford	C	14.18	89
8	Carthage	Hancock	W	14.03	88
9	Lebanon	St. Clair	SW	12.52	78
10	Clayton	Adams	W	12.07	75
11	Bloomington	McLean	C	11.52	72
12	Joliet	Will	NE	9.99	62
13	Carlinville	Macoupin	NSW	8.68	54
14	Antioch	Lake	NE	8.05	50
Sand soil					
15	Oquawka	Henderson	W	7.17	45
Lighter colored soils					
16	Oblong	Crawford	ESE	4.38	27
17	Toledo	Cumberland	ESE	4.23	26
18	Enfield	White	SE	3.52	22
19	Unionville	Massac	SE	3.26	20
20	Newton	Jasper	SE	2.78	17
21	West Salem	Edwards	SE	2.54	16
22	Raleigh	Saline	SE	2.30	14
23	Elizabethtown	Hardin	SE	2.23	14
24	Sparta	Randolph	SW	2.20	14
25	Ewing	Franklin	SE	2.00	12

[1]The average value of the crops for the above period from the Aledo, Dixon, Kewanee, Mt. Morris, and Hartsburg fields, which are representative of soils of good productive levels, was $16 an acre. This value is therefore taken to represent 100 percent in the last column.

When the productivity levels of the respective fields are expressed as percentage variations from $16, the average value for the crops grown on the Aledo, Dixon, Kewanee, Mt. Morris and Hartsburg fields, which may be taken as representing soils of good productivity, comparisons may be quickly made. If these values are correlated with the soil groups listed on page 41, some interesting relationships become apparent. The *darker-colored soils,* for instance, range in productivity levels from 50 to 134 percent of the level of the soils of good productivity. The *lighter-colored soils* range from 12 to 27 percent, which is about one-fifth the level of the darker-colored soils. The *sand soils* occupy a middle position at a 45-percent level. (See page 56 for a graphical presentation of these facts.)

Response to Manure

In livestock systems of farming the amount of manure that can be produced and returned to the soil depends upon the productiveness of the soil. Tests show that when one-third of the produce grown is sold

TABLE 2.—MANURE: AMOUNTS APPLIED TO SOIL IN THREE SYSTEMS OF LIVESTOCK FARMING AND RETURNS FROM IT WHEN USED ALONE
(For the four-year period ending in 1933)

Rank	Field	Amounts applied annually per acre			Value when used alone	
		Alone	With *limestone*	With *limestone* and *rock phosphate*	Ton value	Annual acre-value
		tons	*tons*	*tons*		
1	Dixon	3.01	3.18	3.23	$2.51	$7.55
2	Clayton	2.34	2.97	3.08	2.25	5.26
3	Aledo	3.40	3.93	3.91	1.49	5.07
4	Lebanon	1.92	2.50	2.47	2.84	4.98
5	Kewanee	2.89	3.14	3.33	1.67	4.82
6	Oquawka	1.43	2.16	2.18	3.22	4.60
7	Carlinville	2.17	2.84	3.00	2.03	4.40
8	Mt. Morris	2.68	3.10	3.00	1.63	4.37
9	West Salem	1.00[1]	1.35	1.65	4.33	4.33
10	Carthage	2.61	3.06	3.30	1.66	4.32
11	Hartsburg	3.09	3.47	3.41	1.27	3.91
12	Elizabethtown	.77	1.67	2.19	4.41	3.40
13	Toledo	1.12	2.20	2.09	2.74	3.07
14	Oblong	1.43	2.36	2.51	2.00	2.85
15	Raleigh	.96	1.87	1.94	2.87	2.76
16	Newton	.95	2.06	2.26	2.68	2.47
17	Ewing	.70	2.19	2.25	3.48	2.44
18	Joliet	2.09	2.41	2.75	1.01	2.10
19	Minonk	3.29	3.30	3.25	.60	1.97
20	Unionville	.73	1.30	1.29	2.30	1.68
21	Enfield	.89	2.07	2.23	1.75	1.56
22	Sparta	.81	1.60	1.56	1.65	1.34
23	McNabb	3.59	....	3.71[2]	.05	.18

[1]Light lime application, 4 tons, made in 1912. [2]No limestone.

and two-thirds fed, and allowance is made for one-fifth of the manure to be lost before it can be returned to the land, then for every ton of crops grown one ton of manure containing 25 percent of dry matter and 75 percent moisture can be returned to the soil. When manure was applied to the respective experiment fields on this basis, the amount returned annually per acre, when no supplementary treatments were used, ranged from about ¾ ton on the least productive soils to about 3½ tons on the most productive soils, as may be seen from an inspection of Table 2. With supplementary treatments consisting of either limestone, or limestone and phosphate, the amount of manure returned to the soil on each field was increased, but the extremes in the range of the amounts applied were not greatly different from what they were when no supplementary treatments were used.

The application of manure in the manner described increased the crop yields on all fields. Rather marked differences occurred, however, in the size of the increases on the respective fields. The value of the crop increases where manure alone was used ranged from 18 cents an acre annually at McNabb on a highly productive dark-colored soil to $7.55 an acre at Dixon on a soil of good productivity. In a similar manner the ton-value of the manure applied ranged from 5 cents at McNabb to $4.41 at Elizabethtown on a yellow, low-productive soil. There is a tendency for the smaller applications to give the higher ton-values. This is not always true, however, as may be seen from a comparison of the results from the Elizabethtown and Sparta fields. Somewhat similar amounts of manure were applied at both places, but the ton-value at Elizabethtown was nearly three times as great as at Sparta. In a similar manner 1.92 tons at Lebanon were worth $2.84 a ton, but 2.09 tons at Joliet were worth only $1.01 a ton.

These results indicate that some soils are more highly responsive to manure than others, and that this difference in responsiveness exists in both the more and the less productive soils.

Response to Crop Residues

Farms on which little or no livestock is fed usually produce more or less crop-residue material that may be used for soil improvement purposes. Cropping systems are easily devised in which the amount of such material available for soil improvement can be greatly increased. The value of such materials, as utilized on the soil experiment fields, is shown by the data in Table 3. This material has consisted chiefly of cornstalks, green-manure sweet clover, second-crop red clover and soybean chaff grown upon the land and plowed down in the absence of other soil treatments. In the early years the grain straws were also returned.

This system of soil improvement may be rather effective on some soils and less effective on others, judging from the data in Table 3. The best results have been obtained on those fields where clover, especially sweet clover, will grow without the application of limestone, such as those located on the dark soils with heavy noncalcareous sub-

TABLE 3.—CROP RESIDUES: CROP INCREASES AND VALUES OF INCREASES RESULTING FROM PLOWING DOWN CROP RESIDUES IN ABSENCE OF OTHER SOIL TREATMENT

(Figures represent average annual acre-increases and average annual acre-returns for the four-year period ending in 1933)

Rank	Field	Increases		Value of crop increases	
		Corn	Wheat	Grain crops only	All crops
		bu.	*bu.*		
1	Bloomington	10.0	13.2	$2.83	$4.82
2	Hartsburg	12.8	3.6	3.19	3.19
3	Minonk	8.0	4.3	2.85	2.94
4	Aledo	8.6	3.7	2.17	2.17
5	Kewanee	9.8	6.7	2.62	1.67
6	West Salem[1]	6.1	1.4	1.70	1.44
7	Lebanon	8.7	3.2	2.06	.93
8	Mt. Morris	11.9	1.0	1.93	.78
9	Antioch[2]	1.0	6.7	1.92	.75
10	Oblong	2.7	2.8	.76	.61
11	Raleigh	2.0	1.5	.60	.45
12	Enfield	2.1	.8	.57	.43
13	Newton	− .2	.9	.16	.39
14	Carthage	13.2	2.2	2.21	.37
15	Toledo	2.4	.3	.22	.33
16	Unionville	3.0	.5	.42	.31
17	Joliet	3.7	−1.0	.55	.24
18	Oquawka	4.5	.1	.80	.24
19	Ewing	1.4	1.3	.51	.19
20	Sparta	2.6	− .4	.23	.17
21	Clayton	5.2	4.1	1.67	.15
22	Dixon	9.8	1.7	1.63	.09
23	Carlinville	2.3	.1	.35	.03
24	Elizabethtown	−1.9	.1	− .07	− .05
25	McNabb	−7.0	− .8	−1.45	−2.79

[1]Residues were used in addition to initial application of limestone. [2]Residues were used in addition to limestone and rock phosphate.

soils. The poorest results, on the whole, were obtained on the less productive soils, where legumes grow poorly, if at all, without the application of limestone.

Some of the dark-colored soils that will not grow sweet clover without limestone but which will grow good red clover (such as the Dixon field) do not show high returns for the crop-residues system. This is due, not to the fact that the system has no worth on such soils, but to the fact that in making the comparisons only one crop of clover hay is removed from the residues plot and two are removed from the check plot. This makes it difficult to measure the effects of crop residues on those fields where red clover is grown both as hay and as a residues crop. If the system has worth on such soils, it should be reflected in the grain yields. The fact that the Dixon field shows increased grain yields in the residues system indicates that the system does have worth on that field; this is not true, however, for the McNabb field. (Results from experiments dealing with various phases of crop-residues management are listed on page 46).

Response to Limestone

On most experiment fields an application of 4 tons of limestone an acre in addition to either manure or crop residues was made when the field was established. Subsequent applications were made at the rate of 2 tons an acre each four years thereafter until 1923, when all applications were discontinued. The total amount applied to date to the respective fields ranges from 4 to 10 tons an acre depending upon the age of the field. On most fields a total of about 8½ tons an acre has been applied, which is equivalent to about 700 to 800 pounds an acre annually.

The influence of limestone on soil productivity is probably in large part indirect. Many soils will not satisfactorily grow legume crops such as red clover, sweet clover, and alfalfa until limestone has been

TABLE 4.—LIMESTONE: VALUES OF CROP INCREASES RESULTING FROM LIMESTONE USED IN ADDITION TO MANURE OR TO CROP RESIDUES
(Values represent average annual acre-returns for the four-year period ending in 1933)

Livestock systems			Grain systems		
Rank	Field	Value	Rank	Field	Value
1	Oquawka	$7.00	1	Oquawka	$6.61
2	Ewing	6.67	2	Aledo	6.56
3	Enfield	6.57	3	Lebanon	5.72
4	Oblong	5.76	4	Elizabethtown	5.12
5	Elizabethtown	4.92	5	Sparta	5.06
6	Toledo	4.80	6	West Salem	4.59
7	Raleigh	4.77	7	Carlinville	4.40
8	West Salem	4.55	8	Enfield	4.37
9	Sparta	4.48	9	Carthage	4.17
10	Clayton	4.46	10	Toledo	4.15
11	Newton	4.46	11	Unionville	4.11
12	Unionville	4.15	12	Oblong	3.93
13	Lebanon	3.92	13	Mt. Morris	3.74
14	Carlinville	3.54	14	Clayton	3.72
15	Carthage	2.74	15	Raleigh	3.67
16	Aledo	2.22	16	Ewing	3.57
17	Joliet	2.03	17	Newton	3.57
18	Hartsburg	1.29	18	Bloomington	3.07
19	Mt. Morris	1.25	19	Dixon	2.09
20	Kewanee	1.06	20	Kewanee	1.83
21	Minonk	.13	21	Joliet	1.47
22	Dixon	.12	22	Hartsburg	1.01
			23	Antioch	.34
			24	Minonk	.15

applied. With a satisfactory growth of these legumes, especially when all or a part of the growth is plowed under, striking improvements in soil productivity are usually observed. Altho this increased productivity may result directly from the residues of the legume crops grown, limestone must be given the credit for making the increase possible.

Many of the fields which gave but little response to the crop-residues system of soil management (Table 3) are very greatly improved in productivity after the application of limestone (Table 4). The degree of such improvement appears to be more or less directly related to the natural ability of the soil to grow satisfactory legume crops. The more productive soils that naturally produce more or less satisfactory legume crops give the least response to applications of limestone; those that naturally produce unsatisfactory legume crops give the greatest responses. It is therefore to be expected that soils varying widely in natural productivity will exhibit a wide range in response to limestone.

These data indicate that some soils are in great need of limestone while others have not as yet developed any need for it. Such results emphasize the fact that a definite soil-testing program is needed on every farm. Directions for making the necessary tests are given in Circular 346, "Test Your Soil for Acidity."

Four-Ton Limestone Application Has Long-Time Effect

When the West Salem field was established in 1912, limestone at the rate of 4 tons an acre was applied to each of three plots that were originally designed for crop production without limestone. One of these plots has never received any further treatment; another has received manure alone, and the third has received crop residues only. Similar plots receiving regular applications of limestone were maintained alongside the above plots and continued until 1923, when applications were temporarily discontinued.

The results obtained from these plots are of considerable interest in connection with the lasting effects of a single application of limestone and the time that may be allowed to elapse before additional applications are made (see Table 5).

The single application of limestone steadily advanced the increase in crop yields until the seventh year. During the following two years the increases remained about stationary. Since the ninth year they have grown steadily smaller. After twenty-one years, however, there is still evidence of a decided influence from this one application, and if increases in yield decline no faster than they have declined during

TABLE 5.—LIMESTONE: LASTING EFFECT OF A SINGLE APPLICATION, AND COMPARISON BETWEEN EFFECTS OF SINGLE AND REPEATED APPLICATIONS
(Rotation averages are from the West Salem field, 1913-1933. Crops grown include corn, oats, wheat, and hay)

Year	Average annual acre-increases in crop yields		
	Single application in 1912	Repeated applications in addition to *manure*	Repeated applications in addition to *residues*
	lbs.	*lbs.*	*lbs.*
1913	41	123	20
1914	84	127	81
1915	162	161	178
1916	164	125	185
1917	216	186	243
1918	289	254	339
1919	365	355	435
1920	341	441	418
1921	353	475	444
1922	302	494	430
1923	269	508	371
1924	232	525	375
1925	228	510	394
1926	191	480	379
1927	189	542	424
1928	224	661	578
1929	184	615	550
1930	169	609	546
1931	228	728	659
1932	221	681	634
1933	219	583	547

the past ten years, the influence of the single application will persist for several years yet.

The repeated applications of limestone showed little superiority over the single application until about the eighth year, since which time they have given much better results than the single applications.

These results suggest that a second application of limestone on soils of this character might be delayed until about eight years after the initial application. The increases in crop yields for the repeated applications, even tho none have been made since 1923 still show an upward trend.

Response to Phosphate

On most Illinois soil experiment fields one ton of rock phosphate an acre was applied when the field was started and one ton every four years thereafter until a total of 4 tons was reached. On some fields bone phosphate was applied at the annual rate of 200 pounds an acre until a total of 4,800 pounds was reached. Including all the years of the experiments, rock phosphate has been applied at the annual acre-rate of 350 to 400 pounds and bone phosphate at the rate of 150

TABLE 6.—PHOSPHATE: VALUES OF CROP INCREASES RESULTING FROM PHOSPHATE WHEN USED IN ADDITION TO LIMESTONE AND MANURE OR TO LIMESTONE AND CROP RESIDUES

(Rock phosphate is used except where designated. Values represent average annual acre-returns for the four-year period ending in 1933)

Livestock systems			Grain systems		
Rank	Field	Value	Rank	Field	Value
1	Elizabethtown	$2.87	1	Bloomington[2]	$9.64
2	West Salem	2.55	2	Bloomington	6.09
3	Ewing	1.69	3	Antioch	5.86
4	Enfield	1.32	4	Elizabethtown	5.41
5	Kewanee	1.05	5	Bloomington[3]	4.38
6	Newton	1.05	6	West Salem	3.14
7	Joliet	1.03	7	Joliet	3.13
8	Clayton	1.02	8	Kewanee	2.46
9	Lebanon	.88	9	McNabb[1]	2.20
10	Carlinville	.87	10	Raleigh	1.67
11	Oblong	.70	11	Carlinville	1.66
12	Raleigh	.69	12	Dixon	1.57
13	Oquawka	.67	13	Oblong	1.56
14	Sparta	.66	14	Clayton	1.53
15	Unionville	.52	15	Ewing	1.52
16	Minonk	.20	16	Enfield	1.11
17	Toledo	.01	17	Unionville	1.06
18	Hartsburg	−.06	18	Lebanon	1.00
19	Dixon	−.11	19	Newton	.89
20	Carthage	−.12	20	Toledo	.88
21	Mt. Morris	−.16	21	Carthage	.63
22	Aledo	−.26	22	Aledo	.43
23	McNabb[1]	−.77	23	Hartsburg	.33
			24	Sparta	.17
			25	Mt. Morris	.11
			26	Oquawka	−.12
			27	Minonk	−.13

[1]No limestone. [2]Bone phosphate. [3]Superphosphate.

TABLE 7.—POTASH: VALUES OF CROP INCREASES RESULTING FROM POTASH[1] WHEN USED IN ADDITION TO CROP RESIDUES, LIMESTONE, AND PHOSPHATE

(Values represent average annual acre-returns for the four-year period ending in 1933)

Rank	Field	Value	Rank	Field	Value
1	Ewing	$5.58	13	Carlinville	$1.33
2	Toledo	4.56	14	Antioch[2]	1.31
3	West Salem	3.71	15	Sparta	1.20
4	Enfield	3.62	16	Elizabethtown	1.15
5	Newton	3.24	17	Lebanon	1.07
6	Oblong	2.95	18	Mt. Morris	1.03
7	Bloomington[2]	2.39	19	Carthage	.83
8	Raleigh	2.33	20	Dixon	.63
9	Oquawka	1.74	21	Aledo	.36
10	Unionville	1.63	22	Kewanee	−.05
11	Clayton	1.57	23	Minonk	−.24
12	Joliet	1.44	24	Hartsburg	−.53

[1]Mostly kainit until 1932; since that time, potassium chlorid. [2]Potassium sulfate.

pounds. The results obtained from the use of the phosphates during the last four years are recorded in Table 6.

In general, better responses were obtained in the crop-residues system than in the manure system, probably because the manure functions to some extent as a source of phosphorus. In both systems there are some fields that have given little or no response to phosphorus, probably because the soil has not yet become deficient in available phosphorus or because some other deficiency is of more importance than the phosphorus deficiency.

These results indicate the desirability of testing the soil for available phosphorus as described in Circular 441 of this Station, "Testing Soil for Available Phosphorus," before making plans to use phosphate fertilizers extensively.

Response to Potash

The potash used in these experiments was applied at the annual acre-rate of 200 pounds of kainit or 100 pounds of potassium sulfate or potassium chlorid ahead of corn and wheat.

The more productive soils have given little or no response to potash, the less productive soils the best responses (Table 8). At the Hartsburg, Minonk and Kewanee fields, on soils of high productivity, potash was applied at a loss. At Ewing and other fields, on soils of low productivity, good increases have been obtained.

A careful study of all the experimental data indicates that the favorable results for potash may have been influenced in part by the accompanying treatments. The limestone-sweet-clover treatment especially seems to have increased the effectiveness of the potash on some kinds of soil. More detailed experiments have been started on the Ewing and Toledo fields with reference to this problem. The reader is referred to the Tables on pages 69, 70, 87, and 88 for the 1933 results in these experiments.

Response to Limestone, Phosphate, Potash

The general response of the various kinds of soil represented by the experiment fields to applications of limestone, phosphate, and potash has been indicated by the data in the preceding tables. In this connection it will be of interest to note the differences in responses exhibited by the different crops when grown under different conditions of soil and soil treatment. Such data are presented in Table 8.

On the *darker-colored soils* limestone appears to be more deficient than either phosphate or potash, so far as the growing of corn, oats and wheat is concerned. All three of these crops have responded to

TABLE 8.—LIMESTONE, PHOSPHATE, AND POTASH: RELATIVE CROP RESPONSE TO THESE FERTILIZING ELEMENTS IN A CROP-RESIDUES SYSTEM

Soil type and crop	Actual yields				Relative yields			
	R	RL	RLP	RLPK	R	RL	RLP	RLPK
Grain crops, based on last rotation only								
Darker-colored soils								
Corn, bushels......	53.4	60.8	61.1	62.6	100	113	114	117
Oats, bushels......	53.2	59.4	62.1	63.9	100	112	117	120
Wheat, bushels.....	25.4	29.9	33.7	35.6	100	118	134	140
Lighter-colored soils								
Corn, bushels......	15.7	23.5	24.8	35.1	100	143	158	227
Oats, bushels......	13.0	28.2	31.8	37.8	100	217	245	291
Wheat, bushels.....	7.8	20.5	28.1	35.0	100	263	360	449
Sand soils								
Corn, bushels......	29.2	26.3	27.5	27.4	100	90	94	94
Wheat, bushels.....	11.4	21.6	20.6	22.3	100	189	181	196
Rye, bushels.......	15.9	19.9	20.2	19.6	100	125	127	123
Legume crops, all years								
Darker-colored soils								
Clover (112),[1] tons..	1.37	1.76	1.96	2.03	100	128	143	148
Alfalfa (18),[1] tons...	2.24	2.55	3.40	3.71	100	115	152	166
Clover-alfalfa (14),[1] tons.....	1.41	2.27	2.77	3.10	100	161	196	220
Clover-timothy (2),[1] tons......	1.23	1.30	2.24	2.56	100	106	184	208
Soybeans (46),[1] bushels........	17.6	19.1	19.8	20.3	100	109	112	115
Lighter-colored soils								
Clover (15),[1] tons...	.22	1.21	1.46	1.38	100	550	664	627
Mixed Hay (55),[1] tons..........	.26	.99	1.19	1.69	100	281	458	650
Soybeans (71),[1] bushels........	5.2	10.6	11.4	12.6	100	204	219	242
Sand soils								
Alfalfa (15),[1] tons...	1.28	2.79	2.80	2.89	100	218	219	225
Soybeans (19),[1] bushels........	8.4	12.4	12.5	13.5	100	147	149	161

[1]Figures in parentheses indicate number of crops included in the averages.

the application of limestone. The yields of corn and oats were changed but little by applications of phosphate and potash. Wheat was more favorably affected by both phosphate and potash and especially by the phosphate.

The *lighter-colored soils* present a different situation. Here productivity appears to be affected by deficiencies of all three mineral fertilizer materials. Limestone was highly important in the production of all three grain crops, but it was more important for oats and wheat than for corn. On these soils potash appears to be more important for corn than either limestone or phosphate. For wheat limestone stands first in importance but both phosphate and potash stand high.

The *sandy soil* gave but little response to phosphate and potash. The corn crop was severely handicapped by several very dry hot summers.

A study of the results for the *legume crops* reveals somewhat different relationships. On the dark-colored soils limestone appears to be about twice as important as phosphate in producing good crops of red clover. For alfalfa phosphate is about three times as important as limestone. Potash was of little value to red clover, but was of some value to alfalfa. A combination of red clover and alfalfa responded well to all three minerals, with limestone ranking first and potash last. None of the three fertilizer materials were of much importance in growing soybeans. On the light-colored soils limestone was of much value to soybeans; on the sandy soils limestone was of first importance; phosphate was ineffective; and potash was of some value.

Net Value of Crop Increases

In the livestock system of farming the naturally less-productive soils have tended to give the largest net acre-returns for the various systems of soil treatment (Table 9). In the grain systems of farming such a relationship is not so apparent, some of the more productive fields having given the highest net-acre responses. On the other hand some of the more productive soils have given little or no net response for any system of soil treatment tried. On the McNabb field, for instance, in both systems of farming the check plot gave the highest net returns.

On a large number of the fields the livestock systems of soil treatment have given larger net acre-responses than the grain systems. A few of the more productive soils have given much better responses to the grain systems than to the livestock systems.

From the farmers' point of view, however, the net value of the crop increases is not of so great interest as the total value of all crops with the cost of the treatment deducted. The importance of viewing the data from this standpoint is brought out in Table 10.

Net Values for Total Yields

Ranked by net values of total crops, the Illinois soil experiment fields (Table 10) fall into quite a different order than when arranged according to net value of crop increases. Even tho the net value of the crop increases for soil treatment may be considerably greater on the less productive soils than on the more productive soils, the net value of the total crops produced on the more productive fields is, of course, much greater. This value for the Aledo field was $24.28 an acre during the four-year period ending in 1933, while at Raleigh it was only $4.62. The Aledo field is on a young, dark soil with a heavy noncalcareous subsoil, while the Raleigh field is located on a mature

TABLE 9.—NET VALUES OF INCREASES FROM MOST EFFECTIVE SYSTEMS OF SOIL TREATMENT ON EACH FIELD

(Figures represent annual acre-values of crop increases for the four-year period ending in 1933 after deducting cost of treatment)

Livestock systems				Grain systems			
Rank	Field	Treatment	Value	Rank	Field	Treatment	Value
1	Oquawka	ML	$9.34	1	Aledo	RL	$6.86
2	Ewing	ML	7.43	2	West Salem	RLrPK	6.13
3	West Salem	ML	6.99	3	Bloomington	RLbP	6.09
4	Clayton	ML	6.85	4	Elizabethtown	RLrP	5.11
5	Lebanon	ML	6.79	5	Oquawka	RL	4.91
6	Elizabethtown	ML	6.75	6	Lebanon	RL	4.76
7	Oblong	ML	6.42	7	Antioch	RLrP	3.81
8	Toledo	ML	6.00	8	Ewing	RLrPK	3.69
9	Raleigh	ML	5.65	9	Toledo	RLrPK	3.64
10	Enfield	ML	5.59	10	Sparta	RL	3.36
11	Newton	ML	5.33	11	Enfield	RLrPK	3.17
12	Dixon	M	5.29	12	Oblong	RLrPK	2.95
13	Carlinville	ML	5.14	13	Carthage	RL	2.68
14	Unionville	ML	4.14	14	Mt. Morris	RL	2.66
15	Sparta	ML	4.09	15	Unionville	RL	2.53
16	Carthage	ML	3.99	16	Carlinville	RL	2.51
17	Aledo	ML	3.62	17	Hartsburg	R	2.44
18	Kewanee	M	2.65	18	Newton	RL	2.28
19	Mt. Morris	ML	2.50	19	Raleigh	RL	2.21
20	Hartsburg	ML	1.72	20	Clayton	RL	2.01
21	Joliet	ML	1.45	21	Kewanee	RL	1.68
22	McNabb	0	0	22	Minonk	R	1.63
23	Minonk	0	0	23	Dixon	RL	.35
				24	Joliet	0	0
				25	McNabb	0	0

poorly drained gray soil with impervious noncalcareous subsoil. These figures emphasize the fact that from the farmers' point of view the total acre-production is of much greater importance than the increase that can be obtained for any particular soil treatment. Some soils, it is obvious, challenge the most skilful farming.

Changes have been instituted on certain Illinois fields in an attempt to ascertain whether other crop rotations or other systems of soil treatment than those already tried will make possible a larger net total production.

TABLE 10.—NET VALUES OF TOTAL CROPS FROM MOST EFFECTIVE SYSTEMS OF SOIL TREATMENT ON EACH FIELD

(Figures represent total annual acre-values for the four-year period ending in 1933 after deducting the cost of treatment)

Livestock systems				Grain systems			
Rank	Field	Treat-ment	Value	Rank	Field	Treat-ment	Value
1	McNabb	0	$21.69	1	Aledo	RL	$24.28
2	Dixon	M	21.51	2	McNabb	0	21.69
3	Aledo	ML	21.25	3	Kewanee	RL	18.61
4	Kewanee	M	18.53	4	Dixon	RL	17.80
5	Clayton	ML	18.15	5	Mt. Morris	RL	17.72
6	Mt. Morris	ML	18.11	6	Bloomington	RLbP	17.60
7	Lebanon	ML	17.44	7	Lebanon	RL	17.41
8	Carthage	ML	16.97	8	Hartsburg	R	16.87
9	Hartsburg	ML	15.80	9	Carthage	RL	16.15
10	Minonk	0	15.37	10	Minonk	R	16.02
11	Oquawka	ML	15.27	11	Clayton	RL	14.32
12	Carlinville	ML	13.21	12	Oquawka	RL	13.78
13	Joliet	ML	11.26	13	Antioch	RLrP	11.86
14	Oblong	ML	10.25	14	Carlinville	RL	11.79
15	Toledo	ML	10.23	15	Joliet	0	9.56
16	West Salem	ML	9.53	16	West Salem	RLrPK	8.67
17	Ewing	ML	9.39	17	Oblong	RLrPK	7.55
18	Elizabethtown	ML	8.98	18	Elizabethtown	RLrPK	7.34
19	Enfield	ML	8.82	19	Ewing	RLrPK	7.07
20	Newton	ML	8.19	20	Toledo	RLrPK	6.93
21	Raleigh	ML	7.36	21	Enfield	RLrPK	6.38
22	Unionville	ML	7.30	22	Unionville	RL	5.59
23	Sparta	ML	6.48	23	Sparta	RL	5.31
				24	Newton	RL	5.18
				25	Raleigh	RL	4.62

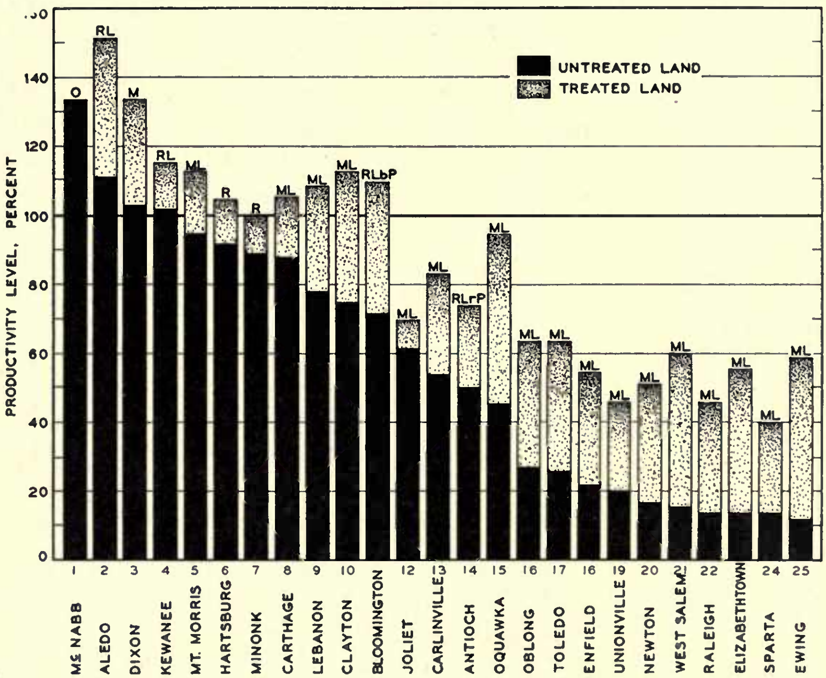
Most Effective Systems of Soil Treatment

Practically every system of soil treatment employed on the Illinois experiment fields has proved the most effective on some field (Tables 9 and 10). On some fields the simplest systems have been the most effective; on others the most complicated systems have given the best results. On the gray, yellow, sandy, hilly, and less productive soils the livestock systems have generally proved of more value than the grain systems, while on some of the more productive dark soils the grain systems have been the more effective.

The fact that no one system of soil treatment will give the best results on all soils is emphasized by these results. A study of these fields by rotation periods (data not presented here) reveals further that the most effective system for any particular field changes from time to time, tending to go from the simpler to the more complex. A clear lesson from these data is that farmers must be constantly on the alert if they are to make the most economic use of their soils.

Effect of Soil Treatment on Productivity Level

Marked differences in the natural productivity levels of twenty-five Illinois soil experiment fields are shown by the data in Table 1. Whether the levels of the less productive soils can be economically raised to those of the naturally more productive soils thru the use of suitable soil treatments is a question that is frequently raised. The answer of these fields to this question at the present time is given in the accompanying graph.



How Soil Treatments Have Influenced the Productivity Levels of Twenty-Five Illinois Experiment Fields

The relative productivity levels of the untreated soil of the above fields is indicated by the black portions of the bars, the average acre-values, in dollars, of the crops grown on the untreated land on five fields of good productivity (Aledo, Kewanee, Dixon, Mt. Morris, and Hartsburg), $16, being taken as 100. The shaded portion of each bar shows the *net value* of the crop increases from the soil treatment that has given the highest net return on the field represented. The low-producing soils, even with the most effective treatments, have reached productive levels only about half as high as the natural level of the better soils. In observing the treatment systems that have netted the highest returns, it should be kept in mind that low crop prices have taken some of the more comprehensive systems temporarily from the list. When better prices prevail, phosphate and potash, or both, will appear more frequently in the treatment systems giving the highest net returns.

In this graph the natural productivity level[1] of each field is represented by the black portion of each bar. The wide range in levels is very striking, the least productive soils — the gray and the yellow — ranking, as an average, less than 20 percent as high as the average of the five fields that are used as the standard of comparison — Aledo, Kewanee, Mt. Morris, Dixon, and Hartsburg.

How effective soil treatment has been in raising the productive levels of these fields is shown by the shaded portion of each bar. This part of the bar represents the increase in crop values resulting from the most effective soil treatment used on the field less the cost of the treatment. The most effective treatments on the less productive soils tended to give greater net increases than the most effective treatments on the more productive soils. With the less productive soils the increases attributable to treatment tend to be several times as large as the yields obtained without treatment. On the more productive soils the yields from the untreated land tend to be several times as great as the increases attributable to treatment. On each field, however, there is at least one treatment that has raised the productivity level of the soil enough to pay for itself.

Whether the crop-producing capacity of the less productive soils can ever be brought up to the natural levels of the better soils seems doubtful, for the present levels represent the effects of treatments applied over periods averaging about twenty-five years. The gray and yellow treated soils today have levels only about 50 percent as high as the natural levels of the better untreated soils.

The question of the economic worth of land in relation to crop production is another matter not discussed in this publication.

Relation of Soil Treatment to Crop Quality

Increases in yield do not measure all the crop benefits from soil treatment; the quality of a crop may be so improved as to be a matter of considerable importance also. Corn grown on some soils is drier and better filled out than that grown on other soils, and because of this the shrinkage between field and market is much reduced.

When corn was grown without treatment on highly productive dark soils with heavy noncalcareous subsoils 71 pounds of ears was required at husking time to make a bushel of shelled corn containing 15.5 percent moisture, which is the allowance for No. 2 shelled corn. This was an average of the past four-year period. A corresponding figure

[1]See Table 1 and discussion on pages 42 to 44 for method of figuring productivity levels.

TABLE 11.—EFFECT OF SOIL TREATMENT ON QUALITY OF CORN PRODUCED: BUSHELS OF CORN (15½ PERCENT MOISTURE) THAT CAN BE MARKETED FOR EVERY 100 BUSHELS (70 POUNDS EARS) HUSKED[1]

(Figures are based on results for the four-year period ending in 1933)

Soil treatment	Dark soils with—					Sandy loams and sands	Yellow soils with noncalcareous subsoils	Gray soils with impervious noncalcareous subsoils	Hilly land
	Heavy noncalcareous subsoils	Noncalcareous subsoils	Impervious noncalcareous subsoils	Impervious calcareous subsoils	Open noncalcareous subsoils				
Number of crops........	24	4	16	8	8	4	8	24	4
	bu.	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*	*bu.*
0......................	98.3	98.5	96.0	92.2	91.6	97.1	92.8	83.0	100.3
M......................	99.4	99.2	97.1	95.4	94.5	99.7	93.1	88.5	100.0
ML.....................	99.4	99.6	98.5	96.2	96.2	99.7	95.1	90.8	99.4
MLP....................	99.2	98.9	98.6	96.0	93.8	99.7	95.6	90.0	99.1
0......................	99.7	97.6	97.0	91.7	91.4	100.6	76.6	85.1	100.3
R......................	98.6	97.4	97.0	96.3	93.5	101.1	87.8	84.1	98.2
RL.....................	100.0	99.4	97.6	96.4	94.1	99.6	90.9	88.5	97.9
RLP....................	100.4	100.3	97.2	98.0	94.6	100.4	91.6	88.3	98.7
RLPK...................	99.9	98.5	97.0	98.2	94.3	97.2	94.3	88.6	89.3

[1]The percentage shrinkage for any soil or treatment practice may easily be calculated by subtraction. In every instance the condition in the field at husking time is represented by 100.

for the untreated dark soils with open noncalcareous subsoils in northern Illinois was 76 pounds, and for the untreated gray soils with impervious noncalcareous subsoils in southern Illinois, 84 pounds.

Stated another way these results mean that corn grown on the first group of soils mentioned above was of such quality that for every 100 bushels (70 pounds to the bushel) husked, there were available for market 98 bushels containing 15.5 percent moisture. Corn grown on the second group made only 92 bushels for market, and corn grown on the last group mentioned made only 83 bushels for market (Table 11).

Further study of the untreated plots in Table 11 shows a rather close relationship between the amount of shrinkage that takes place in corn and the productivity of the soil on which the corn was grown. This relationship does not hold for all soils, however, as may be observed by comparing the figures for the hilly, the sandy, and the dark soils with open noncalcareous subsoils. Differences in the locations of soils with respect to climatic influences may cause yield and quality differences that obscure the influences of inherent soil differences.

Comparison of the shrinkage that has occurred in corn grown on differently treated plots on the same field shows that the raising of the productivity level by soil treatment has, with the exception of the hilly land, reduced the amount of shrinkage between field and market. This fact emphasizes in another way the rather close relation between soil productivity and crop quality.

Thus in a broad way these experiments show that shrinkage is much less when corn is grown on naturally productive soils and soils made productive with suitable treatments than it is when grown on less productive soils.

Units of Measure Used in Tables

In all tables in Part II the figures representing yields of individual crops indicate *bushels per acre* except where they are placed in parentheses, in which case they indicate *tons per acre*. For a key to the symbols representing soil treatments, see pages 40 and 41.

Digestible nutrients per acre, as indicated in the tables, are stated in *pounds*. Since all the crops grown on these fields are used principally as feed or food, their content of digestible nutrients furnishes the best common measure of their value for purposes of making comparisons.

PART II. CROP YIELDS FOR 1933

TABLE 12.—ALEDO FIELD

Rotation: Corn, corn, oats, clover

Serial plot No.	Soil treatment	Series 100 Wheat	Series 200 Oats	Series 200 Stubble hay (Hubam)	Series 300 Second-year corn	Series 300 Stover	Series 400 First-year corn	Series 400 Stover	Digestible nutrients per acre, average all crops	Response index[1]
									lbs.	
	West Half									
1	0	31.8	53.4	(0)	59.6	(1.27)	52.8	(1.38)	2 072	1.000
2	M	31.0	75.0	(0)	83.3	(1.98)	80.2	(1.96)	2 820	1.361
3	ML	42.8	64.4	(.80)	87.9	(2.21)	85.6	(2.40)	3 248	1.569
4	MLrP	43.0	63.1	(.86)	84.1	(1.98)	85.0	(2.25)	3 190	1.540
5	0	23.3	50.9	....	62.0	....	59.0	....	1 920	1.000
6	R	28.8	50.3	....	67.6	....	67.8	....	2 143	1.116
7	RL	48.3	62.8	....	88.3	....	82.1	....	2 840	1.479
8	RLrP	42.8	66.6	....	88.7	....	82.9	....	2 809	1.463
9	RLrPK	45.5	69.1	....	86.2	....	85.0	....	2 850	1.484
10	0	28.8	55.9	....	59.0	....	50.9	....	1 889	1.000
	East Half									
1	RL	38.7	54.4	....	64.5	....	79.3	....	2 380	1.144
2	MrP	37.7	75.6	(0)	80.8	(2.21)	78.2	(2.07)	2 871	1.386
3	MLbP	44.2	73.1	(.62)	81.4	(2.37)	76.0	(2.40)	3 096	1.494
4	MLrP	43.3	70.6	(.70)	82.3	(2.05)	83.9	(2.30)	3 169	1.529
5	RsP	33.7	48.4	....	62.3	....	64.6	....	2 097	1.092
6	RrP	36.3	55.0	....	60.3	....	69.5	....	2 197	1.144
7	RLsP	46.7	63.4	....	60.1	....	83.7	....	2 526	1.316
8	RLrP	46.8	68.4	....	81.1	....	87.4	....	2 832	1.474
9	RLrPK	45.8	70.3	....	85.6	....	85.4	....	2 859	1.489
10	RLrP	39.7	70.9	....	75.2	....	84.0	....	2 657	1.407

[1]The figures in this column (response index) indicate the number of pounds of digestible nutrients produced on the various treated plots for every pound produced on their respective untreated or control plots (see page 46).

TABLE 13.—ALEDO FIELD: PHOSPHORUS STUDIES

Rotation: Corn, corn, oats, wheat

Serial plot No.	Series 500 Soil treatment	Series 500 Oats	Series 600 Soil treatment	Series 600 Oats
1	R	51.4	R	52.7
2	RbP	62.8	RsP	58.9
3	RLbP	70.3	RLsP	67.0
4	RL	53.0	RL	57.0

Serial plot No.	Series 700 Soil treatment	Series 700 Oats	Series 800 Soil treatment	Series 800 Oats
1	R	54.4	R	49.7
2	RrP	58.0	R slag P	56.9
3	RLrP	61.4	RL slag P	57.5
4	RL	57.0	RL	53.6

TABLE 14.—ANTIOCH FIELD
Rotation: Corn, oats, mixed hay, wheat

Plot No.	Soil treatment	Mixed hay	Plot No.	Soil treatment	Mixed hay
1	0	(.57)	6	LRbP	(1.03)
2	LrP	(1.05)	7	LRK	(.92)
3	LRrP	(1.39)	8	LKbP	(1.21)
4	LbP	(1.07)	9	LRKbP	(1.56)
5	LKrP	(1.18)	10	RKbP	(1.23)

TABLE 15.—BLOOMINGTON FIELD
Rotation: Corn, corn, oats, clover-alfalfa, wheat

Plot No.	North Half		South Half	
	Soil treatment	Corn	Soil treatment	Corn
1	R	22.8	0	14.6
2	RLbP	21.0	RL	19.8
3	RLrP	20.7	RLsP	23.5
4	RLbP	18.9	RLbP	24.6
5	RLKrP	24.3	RLKsP	24.8
6	RLbP	24.7	RLbP	26.2
7	RLKrP	32.5	RLKsP	27.9
8	RLKbP	28.1	RLKbP	26.4
9	RLKbP	29.2	RLKbP	27.5
10	RKbP	21.9	RKbP	22.7
11	RrP	16.1	RsP	19.0

Use of Digestible Nutrients as a Common Measure of Year's Yields of All Crops

In studying the effects of soil treatments on the respective fields it is desirable to reduce to one figure all the crops grown in rotation for each individual treatment practice. Money values obviously are not a satisfactory common denominator because of the constant fluctuation of crop prices. Pounds of total produce are not satisfactory because a pound of such produce as hay or stover would be given equal value with a pound of grain. A common denominator which avoids both these disadvantages is *pounds of digestible nutrients*. Since the crops grown in these experiments are food and feed crops, the conversion of the harvested crops to pounds of digestible nutrients provides a satisfactory common denominator for the purpose of making comparisons. This is the method used in this publication.

TABLE 16.—CARLINVILLE FIELD
Rotation: Corn, oats, wheat, clover-alfalfa

Serial plot No.	Soil treatment	Series 100 Oats	Series 200 Wheat	Series 300 Cl.-alf.	Series 400 Soybeans[1]	Digestible nutrients per acre, average all crops	Response index
						lbs.	
1	0	14.1	10.6	(1.44)	10.0	425	1.000
2	M	26.9	30.8	(2.19)	11.6	801	1.885
3	ML	31.3	37.7	(3.69)	10.8	975	2.294
4	MLrP	25.8	40.9	(4.27)	13.1	1 046	2.461
5	0	5.6	17.7	(1.77)	6.7	432	1.000
6	R	4.2	18.2	(1.41)	8.6	439	1.016
7	RL	11.7	24.5	(3.30)	12.6	712	1.648
8	RLrP	11.1	36.5	(3.68)	10.1	837	1.938
9	RLrPK	19.7	39.8	(3.83)	12.9	973	2.021

[1]Soybeans were grown as a substitute for corn.

TABLE 17.—CARLINVILLE FIELD
Rotation: Corn, wheat

Serial plot No.	Soil treatment[1]	Series 500 Wheat	Series 600 Corn	Digestible nutrients per acre, average all crops	Response index[2]
				lbs.	
1	Le	9.8	7.1	394	1.000
2	Le, 8–24–8	28.3	10.1	905	1.467
3	Le, 0–24–8	27.2	15.2	993	1.609
4	Le	19.5	14.2	787	1.000
5	Le, 8–24–8	23.3	13.7	866	1.404
6	Le, 0–24–8	22.7	14.6	872	1.413
7	Le	12.7	16.3	670	1.000

[1]In the beginning, Series 500 and 600 were left unplotted. A rotation of wheat and red clover was planned for one of these series for a period of six years, while alfalfa grew on the other for an equal time, after which the alfalfa was to be shifted. Prior to 1921 these plots had each received a total of 12 tons of manure, 8½ tons of limestone, 3 tons of rock phosphate, and approximately 2,500 pounds of kainit an acre. In 1921 these two series were plotted and, until 1929, were cropped somewhat irregularly without additional fertilization. In 1929 a rotation of corn and wheat (sweet clover) was planned. Fertilizers are being applied as follows: commercial 8–24–8 to Plots 2 and 5, 60 pounds an acre for corn and 125 pounds an acre for wheat; commercial 0–24–8 to Plots 3 and 6, 60 pounds an acre for corn and 125 pounds an acre for wheat.

[2]The yields from Plots 1, 4, and 7 are averaged and used as the check or control for the more heavily treated plots.

TABLE 18.—CARLINVILLE FIELD

Rotation: Corn, wheat

Serial plot No.	Series 700		Series 800	
	Soil treatment[1]	Soybeans[2]	Soil treatment[1]	Soybeans[2]
1	LeL (1,000)	(.39)	LeL (5,000)	(.72)
2	LeL (4,000)	(.37)	LeL (20,000)	(.70)
3	LeL (2,000)	(.34)	LeL (10,000)	(.75)
4	LeL (2,000) treble sP	(.60)	LeL (10,000) treble sP	(1.16)
5	LeL (2,000) sP	(.66)	LeL (10,000) sP	(1.16)
6	LeL (2,000) rP	(.63)	LeL (10,000) rP	(1.18)
7	L (2,000)	(.56)	L (10,000)	(.62)

[1]Figures in parentheses denote the total amounts of limestone per acre applied since 1921. [2]Soybeans were grown as a substitute for corn.

TABLE 19.—CARTHAGE FIELD

Rotation: Corn, oats, clover, wheat

Serial plot No.	Soil treatment	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
	SECTION A							
							lbs.	
1	0	(1.98)	43.8	46.9	(1.76)	23.0	1 659	1.000
2	M	(3.16)	50.9	53.9	(1.82)	28.6	2 160	1.302
3	ML	(3.70)	40.9	61.8	(2.21)	36.2	2 447	1.474
4	MLrP	(3.57)	49.4	68.5	(2.23)	38.4	2 562	1.544
5	0	(2.10)	40.0	45.0	....	30.5	1 650	1.000
6	R	(.92)	45.6	67.5	....	26.4	1 572	.953
7	RL	(1.90)	59.7	77.1	....	36.2	2 136	1.295
8	RLrP	(2.26)	53.4	74.4	....	40.6	2 219	1.345
9	RLrPK	(2.63)	58.1	72.5	....	40.2	2 317	1.404
10	0	(2.95)	48.1	50.5	....	35.8	2 046	1.000
	SECTION B							
1	rP	(2.97)	48.1	46.4	(1.69)	30.7	2 029	1.223
2	M+rP	(3.68)	36.2	51.8	(1.71)	32.4	2 232	1.345
3	ML+rP	(4.15)	32.2	61.0	(2.10)	37.1	2 513	1.515
4	MLrP+rP	(4.07)	36.9	61.6	(2.17)	42.2	2 590	1.561
5	rP	(3.14)	41.9	39.3	....	38.2	1 966	1.192
6	R+rP	(2.16)	55.0	58.1	....	40.2	2 014	1.221
7	RL+rP	(2.68)	49.4	69.4	....	36.0	2 196	1.331
8	RLrP+rP	(2.32)	42.2	75.6	....	36.5	2 136	1.295
9	RLrPK+rP	(3.03)	42.2	73.8	....	41.5	2 364	1.433
10	rP	(3.38)	47.8	49.0	....	41.0	2 204	1.077

(Table 19 is concluded on page 64)

TABLE 19.—CARTHAGE FIELD, *Concluded*

Serial plot No.	Soil treatment	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
				Section C				
							lbs.	
1	sP..................	(2.48)	33.4	47.6	(1.68)	28.8	1 807	1.066
2	M+sP.............	(3.44)	40.9	47.2	(1.73)	32.6	2 147	1.267
3	ML+sP............	(3.67)	37.2	55.4	(1.94)	36.0	2 330	1.404
4	MLrP+sP.........	(3.96)	38.1	60.4	(2.05)	44.1	2 571	1.550
5	sP..................	(2.84)	42.2	37.8	....	40.9	1 903	1.153
6	R+sP.............	(1.72)	51.9	58.5	....	35.6	1 829	1.108
7	RL+sP............	(2.46)	48.8	76.1	....	37.8	2 231	1.358
8	RLrP+sP..........	(2.28)	34.7	72.1	....	36.2	2 040	1.236
9	RLrPK+sP........	(2.44)	38.8	73.7	....	44.3	2 221	1.346
10	sP..................	(2.66)	48.1	42.3	....	33.6	1 851	.905
				Section D				
1	Complete fertilizer...	(2.59)	46.6	47.0	(1.73)	29.8	1 918	1.156
2	M+complete fert...	(3.19)	46.9	48.6	(1.72)	33.5	2 140	1.290
3	ML+complete fert..	(3.49)	49.7	55.4	(2.05)	33.1	2 323	1.400
4	MLrP+complete fert	(3.85)	55.3	56.6	(2.11)	37.9	2 524	1.521
5	Complete fertilizer...	(2.80)	48.4	37.9	....	33.1	1 835	1.112
6	R+complete fert....	(1.62)	51.2	52.8	....	33.2	1 706	1.034
7	RL+complete fert...	(2.62)	52.2	66.2	....	38.4	2 189	1.321
8	RLrP+complete fert	(2.52)	45.9	72.2	....	34.9	2 152	1.304
9	RLrPK+complete fertilizer........	(2.58)	42.5	65.7	....	42.6	2 169	1.308
10	Complete fertilizer...	(3.25)	31.9	46.1	....	32.5	1 946	.951

Note.—For the purpose of studying the relative values of finely processed rock phosphate, superphosphate, and mixed fertilizers when used in addition to different basal soil treatments which have been common to all sections of this field since 1912, these series of plots in 1929 were divided into four sections extending across all plots:

Section A receives the basal treatment only.

Section B receives the basal treatment plus finely processed rock phosphate, 400 pounds per acre for wheat and 125 pounds for corn.

Section C receives the basal treatment plus superphosphate, 250 pounds per acre for wheat and 125 pounds for corn.

Section D receives the basal treatment plus a mixed fertilizer: namely, 125 pounds of 8–24–8 per acre for wheat and 62.5 pounds for corn. Fertilizers in addition to basal treatment on Sections B, C, and D are drilled in for wheat and hill-dropped for corn.

Table 20.—CARTHAGE FIELD
Rotation: Corn, oats, wheat

Serial plot No.	Soil treatment	Series 500 Wheat	Series 500 Stubble hay (sw. cl.)	Series 600 Oats	Series 700 Corn	Digestible nutrients per acre, average all crops	Response index
						lbs.	
1	RL	36.5	(1.31)	40.8	63.5	2 274	1.000
2	RL, KCl	39.9	(1.56)	41.7	71.0	2 530	1.113
3	RL, KCl	30.3	....	55.0	75.9	2 029	1.002
4	RL	30.4	....	59.7	73.1	2 024	1.000

Note.—These series were replotted in the fall of 1930 with the plots extending crosswise of the original plots. A rotation of corn, oats, wheat (sweet clover) is grown. The fall growth of sweet clover is removed from Plots 1 and 2 but allowed to stand on Plots 3 and 4. The soil treatment is as follows: residues (cornstalks and sweet-clover green manure) on all plots; limestone to all plots as necessary for successful growth of sweet clover; potassium chlorid to Plots 2 and 3, 100 pounds per acre drilled with wheat and 50 pounds hill-dropped for corn.

Table 21.—CLAYTON FIELD
Rotation: Corn, oats, clover, wheat

Serial plot No.	Soil treatment	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Series 400 Stubble hay (sw. cl.)	Digestible nutrients per acre, average all crops	Response index
								lbs.	
1	0	(1.19)	41.7	38.5	(1.19)	8.8	(.25)	1 144	1.000
2	M	(2.27)	55.8	61.0	(1.64)	16.1	(.37)	1 871	1.636
3	ML	(3.32)	58.8	76.1	(2.30)	22.7	(.67)	2 449	2.141
4	MLrP	(3.60)	65.0	75.4	(2.21)	24.5	(.77)	2 568	2.244
5	0	(1.72)	42.7	38.8	....	10.7	...	1 258	1.000
6	R	(1.46)	41.9	48.0	....	14.8	...	1 337	1.063
7	RL	(1.56)	51.7	57.7	....	22.9	...	1 624	1.291
8	RLrP	(2.55)	50.3	54.4	....	26.0	...	1 866	1.483
9	RLrPK	(2.74)	48.8	59.1	....	30.0	...	2 021	1.607
10W	Cornstalks	(2.86)	41 6	33.9	....	13.8	...	1 534	1.044
10E	0	(2.92)	35.2	32.5	....	11.2	...	1 469	1.000

TABLE 22.—CLAYTON FIELD
Rotation: Corn, oats, wheat

Serial plot No.	Soil treatment	Series 500 Wheat	Series 600 Oats	Series 700 Corn	Digestible nutrients per acre, average all crops	Response index[1]
					lbs.	
1	RL, commercial 5–15–5	19.7	52.0	44.6	1 370	.962
2	RL, home-mixed 5–15–5	19.9	56.8	65.2	1 716	1.205
3	RL	12.6	55.1	57.6	1 473	1.000
4	RL, home-mixed 0–15–5	26.7	58.3	54.5	1 677	1.177
5	RL, commercial 0–15–0	24.2	57.1	49.1	1 547	1.088
6	Rl	17.5	48.4	49.2	1 376	1.000
7	RL, home-mixed 0–0–5	22.7	55.5	55.7	1 609	1.130
8	RL, commercial 0–0–50	24.5	51.6	60.7	1 684	1.183

Note.—This land grew alfalfa from 1914 to 1920. From 1921 until 1928 a rotation of corn, oats, clover, and wheat was grown. In 1929 these series were laid out and the present rotation (corn, oats, wheat with sweet-clover seeding) was begun. The plan of fertilization is given in the above table:

Residues, consisting of cornstalks and sweet-clover green manure, are plowed down on all plots. Limestone is applied to all plots in sufficient amounts to insure the growth of sweet clover. The additional fertilizers are applied to Plots 1, 2, 4, 5, and 7 at the rate of 200 pounds an acre for wheat and 100 pounds for corn. Plot 8 receives KCl at the rate of 100 pounds an acre for wheat and 50 pounds for corn.

[1]The yields of Plots 3 and 6 are averaged and used as a check for the plots treated with mineral fertilizers.

TABLE 23.—DIXON FIELD
Rotation: Corn, oats, wheat

Soil treatment	Series 900 Corn	Series 1000 Wheat	Series 1100 Oats	Digestible nutrients per acre, average all crops	Response index
				lbs.	
L, all residues	48.6	36.2	55.5	1 719	1.089
L, cornstalks and wheat straw	46.9	28.4	46.2	1 500	.950
L, cornstalks	48.1	33.0	44.6	1 579	1.000
L, cornstalks burned (ash returned)	52.9	35.4	53.0	1 572	.996
L, all residues, sweet clover	83.9	41.4	68.1	2 424	1.535
L, cornstalk, wheat straw, sweet clover	77.6	47.0	65.6	2 334	1.478
L, cornstalks, sweet clover	75.4	42.3	72.6	2 345	1.485
L, cornstalks burned (ash returned), sweet clover	72.0	42.3	66.9	2 252	1.426

Note.—These series were laid out in 1924. A study is being made of the effects of returning crop residues to the soil. Cornstalks are burned on the ground or disked in for oats. Oats straw is returned as a top dressing for wheat, and wheat straw is plowed down for corn. The effects of sweet-clover green manure, in addition to the different combinations of nonlegume residues, are also being studied.

Limestone has been applied to all plots at the rate of 4,000 pounds an acre; subsequent applications will be made as necessary in order to grow a normal crop of sweet clover.

Each yield given is the average of duplicate tests.

TABLE 24.—DIXON FIELD, Rotation: Corn, oats, clover, wheat

Serial plot No.	Soil treatment	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
							lbs.	
	SOUTH HALF							
1	0	(1.77)	53.4	48.9	(1.45)	26.2	1 703	1.000
2	M	(3.12)	67.5	84.1	(2.00)	39.8	2 724	1.600
3	ML	(3.46)	65.9	80.0	(2.06)	42.7	2 798	1.643
4	MLrP	(3.87)	69.7	83.4	(1.91)	42.5	2 954	1.735
5	0	(2.00)	60.0	58.3	....	28.7	1 862	1.000
6	R	(1.12)	59.4	64.6	....	34.8	1 770	.951
7	RL	(1.80)	57.8	72.3	....	36.7	2 051	1.102
8	RLrP	(2.10)	56.6	72.5	....	35.5	2 112	1.134
9	RLrPK	(2.45)	56.6	86.5	....	38.3	2 394	1.286
10	0	(1.31)	49.7	58.0	....	24.0	1 564	1.000
	NORTH HALF							
1	RL	(.78)	47.8	58.2	....	29.5	1 480	.869
2	MrP	(3.39)	66.2	78.6	(1.76)	42.5	2 733	1.605
3	MLbP	(4.03)	70.6	75.6	(1.96)	46.5	2 966	1.742
4	MLrP	(4.31)	70.9	81.2	(1.93)	44.7	3 082	1.810
5	RsP	(.77)	59.7	64.8	....	38.5	1 726	.927
6	RrP	(1.25)	62.5	72.8	....	38.7	1 962	1.053
7	RLsP	(1.47)	62.2	70.7	....	38.5	1 991	1.069
8	RLrP	(2.13)	66.2	74.7	....	34.0	2 180	1.171
9	RLrPK	(2.20)	64.4	92.4	....	37.0	2 420	1.301
10	RLrP	(1.58)	68.1	68.0	....	34.2	1 972	1.261

TABLE 25.—ELIZABETHTOWN FIELD, Corn, winter oats, mixed hay, wheat[1]

Soil treatment	Series 100 Corn	Series 100 Stover	Series 300 Wheat	Series 400 Mixed hay	Series 500 Winter oats	Digestible nutrients per acre, average all crops	Response index
						lbs.	
0	14.0	(.32)	1.8	(0)	11.2	257	1.000
M	30.8	(.71)	8.3	(.31)	32.2	738	2.872
ML	47.2	(1.00)	21.4	(1.64)	53.4	1 544	6.008
MLrP	46.8	(1.04)	27.4	(1.75)	74.1	1 758	6.840
0	14.0	....	1.8	(0)	11.2	241	1.000
R	11.8	....	1.4	(0)	10.3	207	.859
RL	39.4	....	7.6	(.95)	38.8	987	4.095
RLrP	46.2	....	19.4	(2.06)	40.3	1 491	6.187
RLrPK	44.9	....	24.5	(1.80)	68.1	1 628	6.755

[1]In 1932 the rotation was changed to corn, winter oats, standard hay mixture, and wheat. Series 200 was taken out of the system and will be used as a terracing demonstration. Series 500 replaces Series 200 in the cropping system.

TABLE 26.—ENFIELD FIELD
Rotation: Corn, oats, mixed hay, wheat

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
							lbs.	
1	0	(0)	6.3	32.4	(.84)	7.5	530	1.000
2	M	(0)	10.5	36.6	(.95)	14.2	687	1.296
3	ML	(1.30)	17.7	56.8	(1.90)	31.8	1 537	2.900
4	MLrP	(1.54)	16.9	57.5	(2.04)	34.0	1 634	3.083
5	0	(0)	7.5	27.8	....	6.9	436	1.000
6	R	(0)	8.9	30.8	....	8.9	501	1.149
7	RL	(.64)	16.1	28.3	....	22.1	832	1.908
8	RLrP	(.66)	17.5	22.6	....	25.7	824	1.867
9	RLrPK	(1.44)	18.6	51.7	....	32.4	1 432	3.282
10W	Cornstalks	(0)	11.3	30.6	....	12.0	550	1.064
10E	0	(0)	10.9	31.4	....	8.7	517	1.000

TABLE 27.—ENFIELD FIELD
Rotation: Corn, wheat

	Soil treatment[1]	Series 700 Corn	Series 800 Wheat	Digestible nutrients per acre, average all crops	Response index
				lbs.	
1–W	LK	25.4	9.9	807	1.000
1–E	LK	29.9	12.6	972	1.000
2–W	LK, rP, sP, sweet clover	35.3	17.0	1 199	1.486
2–E	LK, rP, sP, red clover	34.3	19.7	1 241	1.276
3–W	LK, rP, sweet clover	30.1	13.2	991	1.225
3–E	LK, rP, red clover	38.1	18.0	1 284	1.321
4–W	LK, rP, sP, sweet clover	30 1	11.5	950	1.177
4–E	LK, rP, sP, red clover	38.6	16.8	1 268	1.304
5–W	LK, rP, sweet clover	28.8	14.0	981	1.215
5–E	LK, rP, red clover	34.5	18.2	1 210	1.245
6–W	LK, sweet clover	19.8	14.9	801	.993
6–E	LK, red clover	29.2	18.5	1 098	1.130

[1]Prior to 1933 these plots had received mineral fertilizers at the following rates: limestone, 4 tons an acre to all plots; rock phosphate, 4,000 pounds an acre to Plots 2 and 3 and 3,000 pounds to Plots 4 and 5; superphosphate, 100 pounds an acre to Plot 2 and 200 pounds to Plot 4. Beginning with 1932, KCl at the rate of 100 pounds an acre is applied to all plots for each crop. Phosphates are applied for each wheat crop: rock phosphate, 400 pounds an acre, to Plots 4 and 5, and superphosphate, 250 pounds an acre, to Plots 2 and 4.

TABLE 28.—EWING FIELD
Rotation: Corn, oats, mixed hay, wheat

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
	SECTION A							
							lbs.	
1	sP, KCl	(0)	0	14.1	(.81)	10.5	324	1.733
2	MsP, KCl	(0)	0	17.0	(1.00)	15.6	428	2.289
3	MLsP, KCl	(2.57)	10.8	45.8	(1.88)	37.2	1 757	9.385
4	MLrPsP, KCl	(1.87)	6.5	50.4	(1.94)	34.8	1 583	8.465
5	sP, KCl	(0)	.6	19.8	....	14.9	404	2.623
6	RLsP, KCl	(.77)	3.9	33.9	....	33.3	993	6.513
7	RLsP, KCl	(1.06)	6.2	43.8	....	31.0	1 162	7.545
8	RLrPsP, KCl	(1.23)	6.5	51.8	....	35.5	1 350	8.766
9	RLrPsPK, KCl	(4.11)	8.8	53.7	....	37.2	2 125	13.799
10	sP, KCl	(0)	1.6	21.1	....	19.4	478	3.104
	SECTION B							
1	KCl	(0)	.6	15.3	(.74)	6.3	287	1.535
2	M, KCl	(0)	4.2	22.7	(.92)	12.2	470	2.514
3	ML, KCl	(2.10)	13.7	51.7	(1.93)	34.0	1 685	9.011
4	MLrP, KCl	(1.96)	7.5	51.3	(1.93)	33.1	1 600	8.556
5	KCl	(0)	2.6	13.1	....	5.7	230	1.494
6	RL, KCl	(.87)	6.5	29.9	....	26.8	910	5.909
7	RL, KCl	(1.04)	8.5	36.0	....	27.3	1 038	6.766
8	RLrP, KCl	(1.66)	5.9	47.0	....	29.7	1 331	8.649
9	RLrPK, KCl	(1.90)	8.8	53.7	....	36.9	1 569	10.188
10	KCl	(0)	2.9	25.2	....	8.6	402	2.610
	SECTION C							
1	0	(0)	3.6	7.9	(.77)	3.3	187	1.000
2	M	(0)	4.9	24.9	(1.02)	5.8	427	2.283
3	ML	(.70)	10.4	50.5	(1.72)	30.5	1 251	6.690
4	MLrP	(1.87)	7.5	56.8	(1.66)	29.8	1 586	8.481
5	0	(0)	2.9	10.8	....	1.4	154	1.000
6	R	(0)	4.6	14.2	....	2.7	217	1.409
7	RL	(.50)	9.8	34.4	....	14.2	736	4.779
8	RLrP	(.63)	7.5	40.5	....	25.2	956	6.208
9	RLrPK	(1.52)	8.1	56.4	....	36.4	1 494	9.701
10	sP	(0)	2.6	26.3	....	13.4	470	3.052

(Table 28 is concluded on page 70)

TABLE 28.—EWING FIELD, *Concluded*

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
	SECTION D							
							lbs.	
1	$NaNO_3$..............	(0)	3.9	11.5	(.58)	2.9	214	1.144
2	M } All fertilizers residual	(0)	6.2	19.4	(.87)	8.9	402	2.150
3	ML } All fertilizers residual	(.68)	8.8	45.0	(1.31)	28.8	1 134	6.064
4	MLrP } All fertilizers residual	(.71)	9.4	54.3	(1.11)	31.0	1 266	6.770
5	$NaNO_3$, KCl..........	(0)	1.3	16.2	....	8.2	287	1.714
6	RL..................	(.63)	7.1	37.0	....	17.5	822	5.338
7	RL (no sw. cl.)........	(.69)	9.1	39.9	....	22.8	944	6.130
8	RLrP (oats straw).....	(1.46)	4.6	49.7	....	26.2	1 262	8.195
9	RLrP, (K residual)....	(1.41)	8.1	57.7	....	29.7	1 400	9.091
10	$NaNO_3$, sP, KCl......	(0)	2.6	31.4	....	14.6	544	3.532

Note.—In order to study the relative values of different methods of fertilization when added to the basal soil treatments that have been common on these series since 1911, the series in 1929 were divided into four sections extending across all plots:

Section A of each plot receives the basal treatment plus KCl at the rate of 100 pounds an acre for wheat, and 100 pounds for corn; also superphosphate at the rate of 250 pounds an acre for wheat and 250 pounds for corn.

Section B receives KCl as on Section A.

Section C continues under the basal treatment except for Plot 10, which receives superphosphate as on Section A.

Section D of the various plots is treated as follows: Plot 1 receives 166 pounds an acre of $NaNO_3$ as a top dressing for wheat and 83 pounds as a side dressing for corn. On Plots 2, 3, and 4 of this section all soil treatments are discontinued. Plot 5 receives $NaNO_3$ as on Plot 1 and KCl as on Section A. On Plot 7 the sweet-clover catch crop is omitted. On Plot 8 oats straw is plowed down for corn at the rate of 2 tons an acre. On Plot 9 kainit is discontinued. Plot 10 receives $NaNO_3$ as on Plot 1 and KCl and superphosphate as on Section A.

Plot 6 in *Sections A*, *B*, and *D* received a 9-ton application of limestone in 1929. No sweet clover will be seeded on this plot in Sections A and B.

TABLE 29.—EWING FIELD
Rotation: Corn, oats, wheat

Serial plot No.	Soil treatment	Series 700 Oats	Series 800 Wheat	Series 900 Corn	Digestible nutrients per acre, average all crops	Response index
					lbs.	
1	RK..........................	4.9	9.4	17.2	444	1.000
2	RK L........................	5.9	16.5	19.5	599	1.349
3	RK LsP (100).................	1.9	24.4	24.1	765	1.724
4	RK LrP (200).................	4.6	25.0	29.2	870	1.960
5	RK L........................	2.6	19.6	20.1	633	1.426
6	RK LsP (200).................	3.6	25.2	32.8	920	2.072
7	RK LrP (400).................	2.9	22.0	37.8	964	2.171

TABLE 30.—EWING FIELD
Rotation: Corn, oats, wheat

Serial plot No.	Soil treatment[1]	Series 500-N Oats	Series 500-S Corn	Series 600 Wheat	Digestible nutrients per acre, average all crops	Response index
					lbs.	
1	RK	2.1	32.8	14.8	742	1.000
2	RK, white biennial sweet clover	3.9	35.7	25.3	967	1.303
3	RK, red clover	3.9	32.8	25.0	899	1.214
4	RK, Hubam clover	3.1	29.3	25.8	873	1.177
5	RK, alsike clover	3.9	38.6	21.3	946	1.275
6	RK, yellow biennial sweet clover	3.1	36.3	18.8	866	1.167

Note.—On these series a study is being made of the relative values of different legume catch crops.

[1]Prior to 1917 all plots had received fertilizers at the following rates per acre: manure 8 tons, limestone 8 tons, rock phosphate 6,000 pounds, and kainit 2,400 pounds. Beginning with 1932, KCl at the rate of 100 pounds per acre is applied broadcast to all plots for corn and wheat.

TABLE 31.—HARTSBURG FIELD (Series 500)
Rotation: Corn, oats, wheat, clover-alfalfa

Plot No.	West		East	
	Soil treatment[1]	Wheat	Soil treatment[1]	Wheat
1	0	24.5	Treble sP	30.0
2	M	19.7	M + treble sP	36.5
3	ML	23.3	ML + treble sP	36.3
4	MLrP	24.7	MLrP + treble sP	35.2
5	0	20.0	Treble sP	33.7
6	R	17.8	R + treble sP	35.2
7	RL	25.8	RL + treble sP	30.3
8	RLrP	22.7	RLrP + treble sP	31.8
9	RLrPK	22.7	RLrPK + treble sP	30.5
10	0	18.8	Treble sP	30.5
11	LeM	21.0	LeM + complete fertilizer	31.5
12	LeML	16.7	LeML + complete fertilizer	30.8
13	LeMLrP	22.2	LeMLrP + complete fertilizer	33.3
14	LeMrP	28.2	LeMrP + complete fertilizer	32.3
15	0	19.0	Complete fertilizer	26.5

[1]With the exception of treble sP and complete fertilizer (8–24–8), all treatments are residual, the last application having been made in 1923.

Treble sP, 111 pounds an acre, and 8–24–8, 125 pounds an acre, were applied ahead of the wheat crop.

TABLE 32.—HARTSBURG FIELD

Rotation: Corn, corn, oats, wheat

Serial plot No.	Soil treatment	Series 100 Wheat	Series 200 Oats	Series 300 Second-year corn	Series 300 Stover	Series 400 First-year corn	Series 400 Stover	Digestible nutrients per acre, average all crops	Response index
	WEST HALF								
								lbs.	
1	0	27.5	34.3	36.0	(1.25)	29.1	(.80)	1 354	1.000
2	M	33.3	38.1	46.2	(1.53)	49.3	(1.30)	1 824	1.347
3	ML	33.2	36.2	41.9	(1.53)	59.2	(1.63)	1 891	1.397
4	MLrP	33.5	37.8	42.2	(1.41)	54.1	(1.48)	1 837	1.357
5	0	25.5	30.3	39.9	....	38.9	....	1 359	1.000
6	R	28.3	32.8	32.5	....	53.2	....	1 483	1.091
7	RL	27.2	31.6	52.9	....	62.7	....	1 798	1.323
8	RLrP	32.3	20.6	35.5	....	70.6	....	1 691	1.244
9	RLrPK	32.3	31.2	36.4	....	64.3	....	1 690	1.244
10	0	21.8	33.8	43.2	....	40.4	....	1 388	1.000
	EAST HALF								
1	RL	24.3	29.1	43.1	....	46.7	....	1 460	1.078
2	MrP	35.5	36.9	46.5	(1.56)	47.6	(1.35)	1 832	1.353
3	MLbP	33.2	38.4	49.5	(1.44)	61.5	(2.20)	2 039	1.506
4	MLrP	36.0	37.5	44.1	(1.56)	59.4	(1.55)	1 957	1.445
5	RsP	34.8	36.6	27.6	....	45.2	....	1 438	1.051
6	RrP	34.5	38.8	39.3	....	59.0	....	1 732	1.274
7	RLsP	35.7	35.6	35.4	....	56.7	....	1 659	1.221
8	RLrP	31.5	45.6	42.3	....	53.7	....	1 709	1.258
9	RLrPK	31.5	32.2	42.5	....	55.9	....	1 660	1.221
10	RLrP	27.7	30.9	47.6	....	39.8	....	1 484	1.062

TABLE 33.—JOLIET FIELD

Rotation: Corn, corn, soybeans, oats, wheat, clover-alfalfa

Serial plot No.	Soil treatment	Series 100 Soybeans	Series 200 Second-year corn	Series 200 Stover	Series 300 First-year corn	Series 300 Stover	Series 400 Clover[1] alfalfa	Series 500 Wheat	Series 600 Oats	Digestible nutrients per acre, average all crops	Response index
										lbs.	
1	0	21.8	18.4	(.56)	19.1	(.41)	(.89)	9.3	27.7	854	1.000
2	M	21.4	23.6	(.96)	20.8	(.74)	(1.48)	8.1	32.7	1 037	1.203
3	ML	20.8	29.1	(1.00)	30.4	(1.00)	(1.80)	9.7	33.3	1 225	1.434
4	MLrP	19.1	27.3	(1.00)	27.9	(.96)	(2.58)	16.1	34.5	1 366	1.600
5	0	20.1	10.8	....	6.4	....	(1.05)	7.6	34.8	694	1.000
6	M	21.7	13.4	....	6.9	....	(.49)	6.2	33.9	621	.892
7	ML	19.3	17.5	....	13.7	....	(.82)	6.2	40.5	761	1.096
8	MLrP	15.8	20.2	....	14.6	....	(1.01)	15.6	41.6	867	1.249
9	MLrPK	17.1	25.9	....	21.6	....	(1.62)	22.5	44.1	1 144	1.648
10	0	19.0	17.9	....	6.5	....	(.81)	15.2	25.8	723	

[1]The second growth was practically all alfalfa. The crop on the residues plots was allowed to mature and was harvested as seed, the yields being at the following acre-rates: Plot 6, .79 bushel; Plot 7, 1.62 bushels; Plot 8, 3.04 bushels; Plot 9, 3.21 bushels an acre. The resulting chaff from each plot was returned to its respective plot.

TABLE 34.—JOLIET FIELD

Rotation: Corn, barley, wheat, legume hay

Serial plot No.[1]	Soil treatment	Series 700 Legume hay	Series 800 Wheat	Series 900 Barley[2]	Series 1000 Corn	Digestible nutrients per acre, average all crops	Response index
						lbs.	
1	RL, red clover	(1.03)	7.6	....	3.5	405	1.000
2	RLrP, red clover	(1.80)	8.6	....	13.9	736	1.351
3	RLrP, gypsum, red clover	(1.42)	9.3	....	28.7	810	1.489
4	RL, red clover	(1.27)	7.8	....	22.7	684	1.000
5	RL, alfalfa	(1.88)	8.3	....	25.9	869	1.000
6	RLrP, alfalfa	(2.96)	10.4	....	30.0	1 214	1.389
7	RLrPL, alfalfa	(3.38)	10.5	....	26.1	1 279	1.463
8	RLrP, KCl, alfalfa	(3.32)	11.0	....	29.9	1 315	1.505
9	RL, KCl, alfalfa	(3.57)	7.5	....	21.3	1 238	1.416
10	RL, alfalfa	(2.32)	8.6	....	16.5	880	1.000
11	RL, red clover	(2.26)	....	....	....	1 195	1.000
12	RLsP, red clover	(2.38)	....	....	....	1 263	1.057
13	LsP, red clover	(1.13)	....	....	....	601	

Note.—In 1924 the rotation on the minor series at Joliet was changed to corn, barley, wheat, and biennial legumes (red clover on Plots 1 to 4 on all series and on Plots 11, 12, and 13 on Series 700 and 900; alfalfa on Plots 5 to 10). All plots have received limestone at the rate of 5,000 pounds an acre. Plot 7 on all series has received in addition 8,000 pounds of limestone an acre. Fertilizers as designated above are applied at the following annual acre-rates: rock phosphate 400 pounds, potassium chlorid 100 pounds, gypsum 100 pounds. These fertilizers are applied twice in the rotation and ahead of the wheat and corn crops. Superphosphate is applied for the wheat crop at the rate of 250 pounds an acre. The last crops of clover and alfalfa are plowed down, excepting on Plots 713 and 913, where they are removed as hay.

[1]Plots 11, 12, and 13 appear only in Series 700 and 900.

[2]Crop was destroyed by chinch bugs.

TABLE 35.—JOLIET FIELD, SPECIAL PHOSPHORUS STUDIES: STUDY OF EFFECTIVENESS OF ROCK PHOSPHATE AT DIFFERENT DEGREES OF FINENESS AND DIFFERENT RATES OF APPLICATION, AND STUDY OF DIFFERENT CARRIERS OF PHOSPHORUS

Rotation: Wheat, clover

Rock phosphate, degrees-of-fineness[1] study		Rock phosphate, rate-of-application study		Comparison of phosphorus carriers	
Soil treatment	Buckwheat[2]	Soil treatment	Buckwheat[2]	Soil treatment	Buckwheat[2]
No phosphate	11.5	No phosphate	12.3	No phosphate	9.9
rP, 99% fine	15.8	rP (250)	13.9	rP (560)	16.7
rP, 95% fine	17.6	rP (500)	16.2	bP (175)	14.4
rP, 90% fine	17.6	rP (1,000)	17.3	sP (280)	14.8
rP, 65% fine	15.5	rP (2,000)	15.8	Treble sP (140)	16.1

Note.—This series was laid out in the fall of 1927. It consists of 75 small plots divided into three groups of 25 plots each. Five soil treatments, replicated five times, are studied in each group.

On Plots 1 to 25 inclusive a study is being made of the relative effectiveness of different degrees of fineness of rock phosphate. The original application of the phosphate was at the rate of 1,000 pounds an acre; a subsequent application of 500 pounds an acre was made for the 1930 wheat crop.

On Plots 26 to 50 inclusive a study is being made of the effects of different rates of application of finely ground rock phosphate.

On Plots 51 to 75 a comparison is made of the effects of different carriers of phosphorus when applied in equal money values. All phosphates are applied broadcast immediately after the wheat is drilled.

[1]Percentage passing thru 100-mesh screen.

[2]Buckwheat was grown as a substitute crop.

TABLE 36.—KEWANEE FIELD
Rotations
Livestock—Corn, oats, clover, wheat; Grain—Corn, corn, oats, wheat

Serial plot No.	Soil treatment	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
							lbs.	
1	0	(1.70)	60.9	59.8	(1.64)	22.4	1 812	1.000
2	M	(3.50)	70.5	77.1	(1.98)	28.7	2 629	1.451
3	ML	(3.56)	73.9	80.9	(2.35)	36.1	2 814	1.553
4	MLrP	(3.47)	68.0	82.6	(2.59)	41.4	2 851	1.573
		Oats	Second-year corn	First-year corn		Wheat	Digestible nutrients	Response index
5	0	63.3	68.0	57.6	....	22.6	2 032	1.000
6	R	60.9	76.3	69.6	....	28.5	2 317	1.140
7	RL	54.7	79.7	81.2	....	37.7	2 561	1.260
8	RLrP	60.2	82.1	85.6	....	40.8	2 705	1.332
9	RLrPK	55.8	87.0	84.1	....	41.0	2 721	1.339

Note.—In order to make a true comparison between livestock and grain cropping systems, the following changes were made in the above field in 1932. Plots 1 to 4 inclusive are continuing to grow the rotation of corn, oats, clover, wheat. On Plots 5 to 9 inclusive a rotation of corn, corn, oats, and wheat has been started. Green-manure crops consisting of Hubam clover with oats and common sweet clover in wheat are being seeded on Plots 6, 7, 8, and 9. Plot 10 has been removed from the standard work and will be used in more intensive investigations.

(See next page for Table 37)

TABLE 38.—KEWANEE FIELD: SPECIAL PHOSPHORUS STUDIES NO. 1
Rotation: Wheat, clover

Rock phosphate, degree-of-fineness study: Soil treatment	Clover	Rock phosphate, rate-of-application study: Soil treatment	Clover	Comparison of phosphorus carriers: Soil treatment	Clover
No phosphate	(3.44)	No phosphate	(2.97)	No phosphate	(2.60)
rP, 99%[1]	(4.22)	rP (250)	(3.08)	rP (560)	(3.52)
rP, 95%	(4.12)	rP (500)	(3.36)	bP (175)	(3.55)
rP, 90%	(4.36)	rP (1,000)	(3.56)	sP (280)	(3.01)
rP, 65%	(4.32)	rP (2,000)	(3.48)	Treble sP (140)	(2.90)

Note.—This series was laid out in the fall of 1927. It consists of 75 small plots divided into three groups of 25 plots each. Five soil treatments, replicated five times, are studied in each group.

On Plots 1 to 25 inclusive a study is being made of the relative effectiveness of different degrees of fineness of rock phosphate. The original application of the phosphate was at the rate of 1,000 pounds an acre; a subsequent application of 500 pounds an acre was made for the 1930 wheat crop.

On Plots 26 to 50 inclusive a study is being made of the effects of different rates of application of finely ground rock phosphate.

On Plots 51 to 75 a comparison is made of the effects of different carriers of phosphorus when applied in equal money values. All phosphates are applied broadcast immediately after the wheat is drilled.

[1]Percentage passing thru 100-mesh screen.

TABLE 37.—KEWANEE FIELD
Rotation: Corn, corn, oats, wheat

Serial plot No.	Soil treatment	Series 500 Oats	Series 600 2nd yr. corn	Series 700 1st yr. corn	Series 800 Wheat	Digestible nutrients per acre, average all crops
						lbs.
1	RrP	73.0	72.6	76.3	40.7	2 527
2	RsP	74.0	74.9	82.4	40.7	3 104
3	RLrP	76.6	81.1	88.9	40.7	3 277
4	RLsP	74.2	75.7	81.8	40.8	3 099

(See preceding page for Table 38)

TABLE 39.—KEWANEE FIELD, SPECIAL PHOSPHORUS STUDIES
NO. 2, ROCK PHOSPHATE
Continuous wheat

Grade	Percent thru 200-mesh screen	1932 Wheat	1933 Wheat	Grade	Percent thru 200-mesh screen	1932 Wheat	1933 Wheat
None	..	42.8	22.6	Fine limestone	..	42.4	23.4
rP (F353)	98	47.6	25.8	rP (300)	82	45.9	24.4
rP (F417)	99	46.0	24.6	rP (302)	62	43.7	25.5
rP (F299)	91	44.8	22.6				

Note.—This series was laid out in the fall of 1931 in order to study the relative effectiveness of fineness of grinding of rock phosphate when applied in smaller amounts than in the preceding experiment (Table 38). This series will grow wheat continuously.

In the fall of 1931 fine-ground limestone was applied to the limed plots at the rate of 2 tons an acre; at the same time the phosphates were applied to the different phosphate plots at rates equivalent to 150 pounds an acre of 13-percent rock phosphate. Each crop yield is the average of five replicates.

TABLE 40.—KEWANEE FIELD, SPECIAL PHOSPHORUS STUDIES NO. 3,
CHEMICALLY PURE PHOSPHATIC MATERIALS
Continuous wheat

Soil treatment	1932 Spring wheat	1933 Wheat	Soil treatment	1932 Spring wheat	1933 Wheat
None	15.9	24.4	$Ca_3(PO_4)_2$	17.5	32.6
Fine limestone	16.0	22.8	$MgH_4(PO_4)_2$	17.6	36.5
$CaH_4(PO_4)_2 \cdot H_2O$	16.9	35.0	$NaH_2PO_4 \cdot H_2O$	16.4	32.3
$CaHPO_4 \cdot 2H_2O$	17.1	32.6	$NH_4H_2PO_4$	18.0	33.9

Note.—This series was laid out in 1932 for the purpose of studying the relative effects of chemically pure phosphatic materials on crop response and also on their chemical behavior in the soil. Wheat will be grown continuously in this experiment.

In the spring of 1932 fine-ground limestone was applied to the limed plots at the rate of 2 tons an acre. The chemically pure phosphates are applied to their respective plots at rates equivalent to 10 pounds an acre of elemental phosphorus and ahead of each wheat crop. Each crop yield is the average of five replicates.

TABLE 41.—LEBANON FIELD
Rotation: Corn, oats, wheat, clover-alfalfa

Serial plot No.	Soil treatment	Series 100 Wheat	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Clover-alfalfa	Digestible nutrients per acre, average all crops	Response index
				SECTION A				
							lbs.	
1	0	24.5	20.9	19.7	(.88)	(.04)	686	1.000
2	M	34.6	35.1	32.0	(1.18)	(1.97)	1 541	2.246
3	ML	37.8	53.4	31.8	(1.32)	(4.16)	2 230	3.250
4	MLrP	39.2	60.4	30.4	(1.17)	(4.19)	2 276	3.318
5	0	27.4	34.8	11.9	....	(2.33)	1 263	1.000
6	R	30.2	33.5	24.5	....	(1.90)	1 319	1.044
7	RL	34.6	59.1	46.3	....	(3.40)	2 149	1.702
8	RLrP	35.8	58.8	51.0	....	(3.39)	2 211	1.751
9	RLrPK	37.1	64.2	58.8	....	(3.51)	2 376	1.881
10	0	25.3	47.4	29.3	....	(1.65)	1 326	1.000
				SECTION B				
1	rP	27.4	21.5	23.8	(.90)	(.05)	774	1.128
2	M + rP	38.5	50.6	30.1	(1.23)	(1.89)	1 635	2.386
3	ML + rP	36.0	57.6	28.2	(1.07)	(4.18)	2 211	3.238
4	MLrP + rP	35.3	61.4	27.0	(1.03)	(4.22)	2 218	3.233
5	rP	31.4	44.2	8.5	....	(3.03)	1 508	1.194
6	R + rP	31.1	38.9	16.7	....	(2.35)	1 389	1.100
7	RL + rP	32.1	57.2	25.4	....	(3.33)	1 856	1.470
8	RLrP + rP	31.9	50.9	38.4	....	(3.26)	1 945	1.540
9	RLrPK + rP	33.4	62.3	54.4	....	(3.37)	2 235	1.770
10	rP	27.7	54.4	32.2	....	(2.56)	1 663	1.179
				SECTION C				
1	sP	23.0	26.2	27.3	(1.03)	(.08)	801	1.168
2	M + sP	25.7	49.3	44.7	(1.52)	(1.40)	1 525	2.223
3	ML + sP	36.3	60.8	21.8	(.99)	(4.39)	2 211	3.223
4	MLrP + sP	37.3	60.8	20.6	(.98)	(4.62)	2 269	3.308
5	sP	36.8	42.4	11.4	....	(2.83)	1 543	1.222
6	R + sP	34.8	34.5	15.5	....	(1.94)	1 289	1.021
7	RL + sP	32.1	53.8	16.6	....	(3.66)	1 824	1.444
8	RLrP + sP	34.3	53.4	20.8	....	(3.65)	1 892	1.498
9	RLrPK + sP	37.8	58.8	42.9	....	(3.54)	2 184	1.729
10	sP	27.0	44.2	35.6	....	(3.01)	1 753	1.322

(Table 41 is concluded on page 77)

TABLE 41.—LEBANON FIELD, *Concluded*

Serial plot No.	Soil treatment	Series 100 Wheat	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Clover-alfalfa	Digestible nutrients per acre, average all crops	Response index
	SECTION D							
							lbs.	
1	Complete fertilizer...	21.4	29.4	30.7	(1.16)	(.41)	930	1.356
2	M + com. fert......	28.2	46.5	42.9	(1.47)	(1.56)	1 559	2.273
3	ML + com. fert.....	29.9	49.9	43.9	(1.49)	(4.34)	2 338	3.408
4	MLrP + com. fert...	33.8	59.8	29.3	(1.15)	(4.21)	2 221	3.238
5	Complete fertilizer...	23.1	41.8	19.2	....	(2.48)	1 371	1.086
6	R + com. fert......	31.4	29.8	33.6	....	(1.98)	1 435	1.136
7	RL + com. fert.....	32.2	55.7	31.8	....	(3.42)	1 944	1.539
8	RLrP + com. fert...	33.9	54.7	25.6	....	(3.57)	1 978	1.550
9	RLrPK + com. fert.	35.1	55.0	31.1	....	(3.51)	1 990	1.576
10	Complete fertilizer...	30.7	26.9	38.3	....	(3.02)	1 744	1.315

Note.—For the purpose of studying the relative values of finely processed rock phosphate, superphosphate, and mixed fertilizers when used in addition to different basal soil treatments which have been common to all sections of this field since 1912, these series of plots in 1929 were divided into four sections extending across all plots:

Section A receives the basal treatment only.

Section B receives the basal treatment plus finely processed rock phosphate, 400 pounds an acre for wheat and 125 pounds for corn.

Section C receives the basal treatment plus superphosphate, 250 pounds an acre for wheat and 125 pounds for corn.

Section D receives the basal treatment plus a mixed fertilizer; namely, 125 pounds of 8-24-8 an acre for wheat and 62.5 pounds for corn. On Sections B, C, and D all fertilizers in addition to the basal treatment are drilled in for wheat and hill-dropped for corn.

TABLE 42.—LEBANON FIELD
Rotation: Corn, oats, wheat

Serial plot No.	Soil treatment[1]	Series 500 Wheat	Series 600 Corn	Series 700 Oats	Digestible nutrients per acre, average all crops	Response index
					lbs.	
1-W	Le........................	20.9	28.4	19.9	907	1.000
1-E	Le + sP..................	22.4	26.7	25.9	950	1.407
2-W	LeM......................	26.9	33.1	19.3	1 069	1.179
2-E	LeM + sP.................	34.6	32.8	27.3	1 247	1.375
3-W	LeML.....................	26.0	47.0	31.0	1 349	1.487
3-E	LeML + sP................	36.1	50.5	41.6	1 642	1.810
4-W	LeMLrP...................	25.9	48.1	33.7	1 384	1.526
4-E	LeMLrP + rP..............	34.1	52.7	40.8	1 637	1.806

[1]No manure or limestone has been applied since 1921. No rock phosphate has been applied on 4-W since 1921.

TABLE 43.—LEBANON FIELD
Rotation: Wheat, potatoes

Serial plot No.	Soil treatment	Series 800 Potatoes	Series 900 Wheat	Digestible nutrients per acre, average all crops
				lbs.
1	LeM	57.3	32.2	1 065
2	LesP	57.8	33.4	1 097
3	LerP	52.0	33.1	1 060
4	LesPK	65.3	37.0	1 221
5	LerPK	50.8	37.3	1 200
6	Le, straw	81.7	35.1	1 254
7	LesP, straw	83.2	33.9	1 233
8	LerP, straw	90.5	33.4	1 263
9	Le, treble superphosphate	49.8	36.1	1 120
10	Le, potassium phosphate	54.7	35.1	1 121

Note.—In 1925 Series 800 and 900 were laid out on land which had received 8,000 pounds of limestone, 2,000 pounds of rock phosphate, and 15 tons of manure an acre in 1911. The land grew alfalfa almost continuously from 1911 to 1925. A rotation of wheat (sweet-clover catch crop) and potatoes is followed. Fertilizers are applied as indicated above. The phosphates are applied annually: rock phosphate, at the rate of 400 pounds an acre; superphosphate, 200 pounds; treble superphosphate, 100 pounds; and potassium phosphate, 200 pounds. Kainit, 200 pounds an acre, is applied for each potato crop. Two tons of manure is applied for potatoes. Straw is applied as a mulch when the potatoes are coming thru the ground.

TABLE 44.—McNABB FIELD
Rotation: Corn, oats, wheat, clover

Serial plot No.	Soil treatment	Series 100 Oats	Series 200 Corn	Series 200 Stover	Series 300 Clover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
							lbs.	
1	R	55.3	73.8	....	(1.82)	37.2	2 248	.866
2	RrP	75.9	83.0	....	(1.69)	40.8	2 292	.904
3	0	82.8	83.9	....	(2.46)	40.0	2 536	1.000
4	MrP	84.4	80.8	(3.00)	(2.25)	41.0	2 616	1.032
5	M	80.0	83.1	(3.12)	(2.06)	40.3	2 564	1.011

TABLE 45.—MINONK FIELD
Rotation: Corn, corn, oats, wheat

Serial plot No.	Soil treatment[1]	Series 100 Wheat	Series 200 Oats	Series 300 Second-year corn	Series 300 Stover	Series 400 First-year corn	Series 400 Stover	Digestible nutrients per acre, average all crops	Response index
	SOUTH HALVES OF PLOTS								
								lbs.	
1	0	27.5	45.0	34.8	(.91)	33.2	(1.10)	1 444	1.000
2	M	30.0	36.9	36.6	(1.04)	41.0	(1.18)	1 547	1.075
3	ML	27.6	35.9	39.0	(1.03)	39.1	(1.20)	1 519	1.052
4	MLrP	26.7	40.0	40.6	(1.10)	40.8	(1.22)	1 572	1.089
5	0	25.1	40.0	28.4	....	27.9	....	1 156	1.000
6	R	31.0	33.8	39.2	....	36.9	....	1 413	1.222
7	RL	31.0	41.2	41.5	....	42.4	....	1 542	1.334
8	RLrP	33.0	44.7	42.4	....	42.3	....	1 595	1.380
9	RLrPK	31.2	43.8	36.9	....	39.7	....	1 478	1.279
10	0	23.6	40.0	25.6	....	35.7	....	1 194	1.000
	NORTH HALVES OF PLOTS								
1	N	31.2	43.1	30.6	(.93)	35.8	(1.15)	1 463	1.013
2	MN	35.9	45.3	34.3	(.86)	46.5	(1.25)	1 695	1.174
3	MLN	31.3	30.6	41.2	(1.17)	42.1	(1.32)	1 604	1.111
4	MLrPN	31.0	37.8	37.4	(1.12)	39.3	(1.33)	1 566	1.084
5	N	30.3	42.2	28.8	....	29.0	....	1 247	1.079
6	RN	33.4	47.2	34.2	....	39.4	....	1 489	1.288
7	RLN	31.0	40.9	40.0	....	41.9	....	1 518	1.313
8	RLrPN	31.7	44.1	37.8	....	44.4	....	1 548	1.339
9	RLrPKN	31.0	45.9	38.9	....	41.4	....	1 529	1.323
10	N	26.8	45.3	27.5	....	39.8	....	1 329	1.113

[1]On the north halves of all plots nitrogen fertilizers are applied as follows: *For first-year corn,* sodium nitrate, 83 pounds an acre (applied with a special hand distributor or jabber on both sides of the hill and about an inch below the surface) at emergence, and ammonium sulfate, 83 pounds an acre when the corn is about 12 inches high. *For wheat,* ammonium sulfate at the rate of 165 pounds an acre is applied broadcast as a top dressing about April 15.

Units of Measure Used in Tables

In all tables in Part II the figures representing yields of individual crops indicate *bushels per acre* except where they are placed in parentheses, in which case they indicate *tons per acre.* For a key to the symbols representing soil treatments, see pages 40 and 41.

Digestible nutrients per acre, as indicated in the tables, are stated in *pounds.* Since all the crops grown on these fields are used principally as feed or food, their content of digestible nutrients furnishes the best common measure of their value for purposes of making comparisons.

TABLE 46.—MT. MORRIS FIELD

Rotations

Livestock—Corn, oats, clover, wheat; Grain—Corn, corn, oats, wheat

Serial plot No.	Soil treatment	Series 100 Clover	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
							lbs.	
1	0	(1.24)	34.8	66.2	(1.72)	15.8	1 540	1.000
2	M	(2.64)	41.7	79.6	(1.86)	23.8	2 203	1.431
3	ML	(3.35)	46.1	81.2	(1.84)	30.0	2 508	1.626
4	MLrP	(3.05)	45.6	79.9	(1.86)	30.8	2 421	1.572
		Oats	Second-year corn	First-year corn		Wheat	Digestible nutrients	Response index
5	0	36.3	46.3	50.9	....	11.9	1 434	1.000
6	R	39.8	63.1	63.7	....	12.4	1 792	1.250
7	RL	35.6	80.3	78.0	....	21.2	2 227	1.553
8	RLrP	40.3	76.2	82.9	....	25.2	2 310	1.611
9	RLrPK	39.8	75.3	87.5	....	27.8	2 380	1.660
10–W	Cornstalks	36.2	61.7	52.4	....	8.9	1 588	1.105
10–E	0	37.8	54.7	46.1	....	8.0	1 437	1.000

Note.—In order to make a true comparison between livestock and grain cropping systems, the following changes were made in 1932: Plots 1 to 4 inclusive are continuing to grow the rotation of corn, oats, clover, and wheat. On Plots 5 to 10 a rotation of corn, corn, oats, and wheat has been started. As a green-manure crop on Plots 6, 7, 8, and 9, Hubam clover is seeded with oats and common sweet clover in wheat.

TABLE 47.—MT. MORRIS FIELD

Rotation: Corn, barley, clover-alfalfa, alfalfa

Serial plot No.	Soil treatment	Series 500 Corn	Series 600 Alfalfa[1]	Series 700 Alfalfa	Series 800 Barley	Digestible nutrients per acre, average all crops	Response index
						lbs.	
1	0	76.5	(2.51)	(1.14)	15.2	1 932	1.000
2	M	81.1	(3.09)	(1.45)	17.8	2 490	1.288
3	ML	93.8	(3.20)	(3.06)	22.5	2 860	1.480
4	MLrP	78.0	(3.37)	(3.16)	23.4	2 753	1.425

[1]Alfalfa was grown as a substitute for clover-alfalfa.

TABLE 48.—MT. MORRIS FIELD
Rotation: Corn, oats, wheat, hay

Soil treatment	Series 900 Corn	Series 1000 Hay	Series 1100 Wheat	Series 1200 Oats	Digestible nutrients per acre, average all crops	Response index
					lbs.	
L, timothy	55.0	(.90)	18.2	33.0	1 240	1.000
LrP, timothy	59.4	(1.09)	20.3	33.3	1 362	1.098
L, red clover	67.2	(4.01)	21.4	46.1	2 330	1.789
LrP, red clover	76.2	(3.87)	23.4	44.5	2 409	1.943
L, alfalfa	78.3	(3.40)	22.2	40.2	2 236	1.803
LrP, alfalfa	78.8	(2.73)	25.1	47.8	2 148	1.732
L, soybeans	58.4	(3.62)	22.6	37.1	1 893	1.527
LrP, soybeans	65.7	(3.65)	23.5	35.3	1 982	1.598

Note.—These series were laid out for the purpose of studying the relative influence of different forage crops on subsequent grain yields in a four-year rotation of corn, oats, wheat, and hay grown on limed and limed-phosphated land. All plots have received 2 tons of limestone an acre. Rock phosphate is applied at the rate of 400 pounds an acre for corn and 400 pounds for wheat. Four different forage crops (timothy, red clover, alfalfa, and soybeans) are grown in duplicate in both systems of soil treatment. The forage crops are removed as hay.

TABLE 49.—NEWTON FIELD
Rotation: Corn, oats, wheat, redtop

Serial plot No.	Soil treatment	Series 100 Oats	Series 200, Redtop Seed	Series 200, Redtop Threshed hay	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
								lbs.	
1	0	3.9	6.7	(.83)	8.6	(.50)	0	363	1.000
2	M	4.2	7.9	(.70)	19.1	(.71)	3.1	494	1.361
3	ML	11.4	8.6	(1.14)	35.4	(1.42)	16.8	1 035	2.851
4	MLrP	12.7	8.6	(1.39)	38.0	(1.55)	24.7	1 239	3.413
5	0	4.8	6.2	(.66)	12.0	....	0	337	1.000
6	R	2.2	7.8	(.75)	12.8	....	0	354	1.050
7	RL	5.8	10.2	(.98)	9.9	....	4.2	454	1.347
8	RLrP	9.2	4.4	(.74)	6.6	....	9.9	442	1.312
9	RLrPK	7.8	9.6	(1.46)	29.1	....	22.1	1 022	3.033
10–N	Cornstalks	1.6	6.1	(.61)	12.7	....	0	313	1.164
10–S	0	1.6	5.6	(.51)	11.1	....	0	269	1.000

TABLE 50.—NEWTON FIELD

Rotation: Corn, wheat, lespedeza-sweet-clover-redtop mixture

Serial plot No.	Soil treat-ment	Limestone fineness (meshes per inch)	High-calcium limestone: Series 500[1] Sweet clover seed	Series 500[1] Redtop seed	Series 700 Wheat	Series 900 Corn	Digestible nutrients per acre, average all crops	Response index[2]	Dolomitic limestone: Series 600[1] Sweet clover seed	Series 600[1] Redtop seed	Series 800 Wheat	Series 1000 Corn	Digestible nutrients per acre, average all crops	Response index[2]
							lbs.						*lbs.*	
1	RrPK......	......	0	1.9	6.8	17.2	581	1.000	0	2.0	8.5	18.0	607	1.000
2	RrPKL.....	4—down	.2	3.4	13.8	19.2	792	1.342	.4	3.8	17.2	21.8	901	1.267
3	RrPKL.....	4 to 10	.4	2.4	16.1	20.6	858	1.454	2.8	.4	20.2	24.3	1 030	1.449
4	RrPKL.....	10—down	.1	2.4	14.3	21.2	818	1.386	1.5	0	16.4	24.1	933	1.312
5	RrPKL.....	50—down	.2	1.6	14.2	27.0	946	1.603	.4	0	13.4	26.3	910	1.280
6	RrPKL.....	Burnt	.6	0	12.0	23.8	821	1.392	.6	0	12.7	30.2	981	1.380
7	RrPK......	......	0	1.4	8.5	17.7	600	1.000	0	1.4	8.7	27.1	816	1.000
8	RrPKL.....	4—down	.8	0	20.1	24.5	1 031	1.812	1.5	0	21.1	40.2	1 407	2.100
9	RrPKL.....	4 to 10	.8	0	22.1	24.1	1 070	1.880	1.5	0	21.4	37.0	1 342	2.003
10	RrPKL.....	10—down	.8	0	21.4	20.2	966	1.698	1.6	0	20.3	31.8	1 210	1.806
11	RrPKL.....	50—down	.6	0	22.2	18.5	948	1.666	1.6	0	20.2	19.9	931	1.389
12	RrPKL.....	Burnt	.4	.7	22.0	16.8	904	1.764	1.4	0	17.4	16.2	780	1.164
13	RrPK......	......	0	1.4	7.1	16.4	538	1.000	0	2.3	6.9	16.0	524	1.000
14	RrPKL.....	4—down	.6	0	24.8	13.2	890	1.184	1.6	0	25.4	19.4	1 044	1.366
15	RrPKL.....	4 to 10	.5	0	25.6	12.8	901	1.198	1.0	0	25.7	35.1	1 403	1.836
16	RrPKL.....	10—down	.4	0	25.3	14.6	934	1.242	1.3	0	28.1	35.9	1 479	1.936
17	RrPKL.....	50—down	.4	0	27.0	22.7	1 157	1.539	1.0	0	26.4	23.9	1 114	1.458
18	RrPKL.....	Burnt	.4	0	26.1	37.0	1 456	1.936	.9	0	26.3	33.0	1 370	1.911
19	RrPK......	......	0	1.4	6.2	36.5	967	1.000	0	1.2	6.6	37.8	1 005	1.000

Note.—Lime materials have been applied in amounts equivalent to pure calcium carbonate as follows: to Plots 2 to 6, 500 pounds an acre a year; to Plots 8 to 12, 1,000 pounds; to Plots 14 to 18, 2,000 pounds. The total amounts applied since 1913 are 3 tons, 6 tons, and 12 tons respectively. No more will be applied until there appears to be need for it.

[1]Sweet clover and redtop were seeded in 1932 but the redtop failed on most of the limed plots. In the spring of 1933 Korean lespedeza was seeded on all plots but failed to mature a seed crop.

[2]The average of Plots 1 and 7 are checks for the first group of limed plots, the average of Plots 7 and 13 for the second group, and the average of Plots 13 and 19 for the third group.

TABLE 51.—OBLONG FIELD

Rotation: Corn, oats, mixed hay, wheat

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300		Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
				Corn	Stover			
	SOUTH HALF							
							lbs.	
1	0	(.02)	3.8	25.0	(.80)	9.2	457	1.000
2	M	(.04)	9.1	30.0	(.88)	19.8	678	1.484
3	ML	(1.12)	25.2	50.1	(1.35)	33.3	1 449	3.171
4	MLrP	(1.51)	24.9	51.9	(1.62)	35.1	1 601	3.503
5	0	(.03)	14.8	23.9	....	14.7	534	1.000
6	R	(.03)	10.8	27.6	....	15.2	560	1.049
7	RL	(1.37)	19.5	34.9	....	20.8	1 092	2.045
8	RLrP	(1.09)	18.0	42.8	....	24.5	1 147	2.048
9	RLrPK	(1.61)	19.3	57.3	....	29.2	1 503	2.811
10	0	(.01)	6.4	31.8	....	10.7	523	1.000
	NORTH HALF							
1	RLsP	(.12)	6.6	25.7	....	22.0	619	1.354
2	MLrP	(1.00)	10.5	41.8	(1.38)	27.9	1 180	2.582
3	MLbP	(1.75)	20.1	55.2	(1.88)	35.0	1 682	3.681
4	MLrP	(1.59)	23.3	46.0	(1.58)	31.0	1 494	3.269
5	RL, under-acidulated P	(.06)	14.5	29.7	....	21.5	687	1.287
6	RLrP	(.36)	18.2	36.1	....	22.5	866	1.622
7	RLbP	(1.20)	20.1	39.6	....	23.6	1 139	2.133
8	RLrP	(1.13)	16.4	40.0	....	23.5	1 104	2.067
9	RLrPK	(1.54)	17.7	56.4	....	30.0	1 476	2.764
10	RL, potassium P	(.58)	9.6	42.2	....	20.5	918	1.755

TABLE 52.—OQUAWKA FIELD

Rotation: Corn, soybeans, rye, clover-alfalfa, wheat, alfalfa

Serial plot No.	Soil treatment	Series 100 Clover-alfalfa	Series 200 Rye	Series 300 Alfalfa	Series 400 Soybeans	Series 500		Series 600 Wheat	Digestible nutrients per acre, average all crops	Response index
						Corn	Stover			
									lbs.	
1	0	(0)	15.4	(.67)	11.8	11.2	(.55)	10.6	530	1.000
2	M	(.54)	22.6	(2.68)	12.2	21.2	(.85)	16.4	1 155	2.179
3	ML	(2.71)	27.8	(4.77)	10.1	31.6	(1.23)	21.1	2 033	3.836
4	MLrP	(2.66)	27.9	(4.84)	9.8	27.7	(1.02)	21.0	1 998	3.770
5	0	(.30)	20.4	(1.10)	9.8	14.5	....	10.3	678	1.000
6	R	(.14)	21.2	(.96)	11.4	18.0	....	7.2	649	.957
7	RL	(1.04)	24.5	(4.17)	11.0	35.7	....	13.0	1 550	2.286
8	RLrP	(1.09)	26.2	(4.03)	9.9	39.5	....	10.4	1 545	2.279
9	RLrPK	(1.17)	25.4	(4.28)	13.2	48.6	....	15.1	1 732	2.555
10–W	Cornstalks	(0)	20.4	(.02)	9.5	38.3	....	8.3	601	1.015
10–E	0	(0)	15.7	(.02)	9.3	31.9	....	5.3	592	1.000

TABLE 53.—RALEIGH FIELD
Rotation: Corn, oats, mixed hay, wheat

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
	WEST HALF							
							lbs.	
1	0	(0)	0	11.8	(.60)	5.4	227	1.000
2	M	(0)	1.3	34.5	(.97)	12.6	593	2.612
3	ML	(.30)	4.6	52.2	(1.76)	25.1	1 075	4.736
4	MLrP	(.61)	5.2	46.0	(1.76)	30.1	1 146	5.048
5	0	(0	0	14.7	....	6.6	244	1.000
6	R	(0)	0	17.9	....	10.4	325	1.332
7	RL	(.14)	5.9	37.9	....	19.8	730	2.992
8	RLrP	(.12)	3.9	45.1	....	26.6	876	3.590
9	RLrPK	(.11)	3.9	53.9	....	32.2	1 040	4.262
10	0	(0)	0	25.2	....	8.8	388	1.000
	EAST HALF							
1	RL	(.10)	1.9	29.8	....	16.5	357	1.573
2	MrP	(0)	0	55.1	(1.42)	27.8	578	2.546
3	MLbP	(1.12)	2.5	56.6	(1.69)	31.7	1 030	4.537
4	MLrP	(.80)	3.6	56.5	(1.85)	31.0	1 033	4.551
5	RsP	(0)	0	32.4	....	22.0	399	1.635
6	RrP	(0)	0	38.7	....	28.7	500	2.049
7	RLsP	(.42)	4.8	38.8	....	28.3	808	3.311
8	RLrP	(.09)	3.4	42.7	....	27.9	648	2.656
9	RLrPK	(.17)	2.7	61.3	....	31.3	801	3.283
10	RLrP	(0)	3.9	36.5	....	23.1	942	2.428

TABLE 54.—SPARTA FIELD

Rotation: Corn, cowpeas, timothy-vetch, wheat

Serial plot No.	Soil treatment[1]	Series 500 Cowpeas	Series 600 Hay[2]	Series 700 Wheat	Series 800 Corn	Digestible nutrients per acre, average all crops	Response index[3]
			SECTION A (Timothy-vetch)				
						lbs.	
1	R	(.35)	(.29)	16.6	9.9	453	1.079
2	RM	(.79)	(.46)	22.6	7.8	633	1.507
3	RML	(.53)	(1.10)	37.4	12.7	969	2.307
4	RMLrP	(.35)	(1.33)	44.2	14.4	1 089	2.593
5	RMLrPK	(.29)	(.94)	43.0	14.6	979	2.331
6	R	(.88)	(.17)	20.1	10.0	576	1.371
			SECTION B (Timothy)				
1	R	(.47)	(.24)	15.1	10.8	457	1.000
2	RM	(.42)	(.42)	18.2	7.8	495	1.179
3	RML	(.38)	(1.20)	29.6	13.1	874	2.081
4	RMLrP	(.81)	(1.20)	31.6	14.3	1 000	2.381
5	RMLrPK	(.36)	(1.20)	34.0	13.2	923	2.197
6	R	(.19)	(.28)	15.6	7.8	382	1.000

[1]Manure, lime and phosphate are residual. [2]Hay consists of timothy and vetch on Section A and timothy alone on Section B. [3]The average of Plots 1 and 6 in Section B is the check for all other plots in both sections.

TABLE 55.—SPARTA FIELD

Nitrate Studies

Soil treatment	Plot E Corn	Plot F Wheat
LeL, $NaNO_3$	2.4	14.6
LeL	2.9	13.9

TABLE 56.—SPARTA FIELD

Rotation: Corn, soybeans, oats, wheat

Serial plot No.	Soil treatment	Series 100 Oats	Series 200 Soybeans	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
	Section A							
							lbs.	
1	0	15.1	(.17)	2.3	(.60)	3.4	217	1.000
2	M	17.1	(.03)	3.2	(.80)	6.1	251	1.158
3	ML	49.2	(.05)	9.6	(1.20)	33.8	859	3.959
4	MLrP	40.2	(.05)	8.3	(1.20)	41.8	890	4.101
5	0	15.4	(.01)	.7	....	5.3	160	1.000
6	R	17.1	(.04)	3.2	....	2.9	175	1.094
7	RL	35.4	(.11)	5.2	....	28.0	616	3.850
8	RLrP	35.7	(.05)	2.3	....	30.8	606	3.788
9	RLrPK	42.8	(.22)	6.4	....	36.4	794	4.962
10	0	23.8	(.06)	3.2	....	3.9	228	1.000
	Section B							
1	sP, KCl	16.4	(.31)	12.2	(1.20)	6.1	427	1.968
2	M, KCl	22.5	(.11)	7.1	(1.00)	8.0	374	1.724
3	ML, KCl	46.4	(.05)	8.8	(1.25)	33.5	858	3.954
4	MLrP, KCl	42.5	(.08)	9.6	(1.15)	36.9	862	3.972
5	KCl	18.0	(.15)	1.3	....	14.4	320	2.000
6	R, KCl	21.2	(.20)	3.7	....	13.6	366	2.288
7	RL, KCl	44.4	(.50)	8.8	....	31.8	834	5.212
8	RLrP, KCl	44.4	(.46)	7.6	....	31.3	806	5.038
9	RLrPK, KCl	47.3	(.56)	8.5	....	37.2	949	5.931
10	sP, $NaNO_3$, KCl	27.7	(.26)	3.1	....	20.4	489	2.145

Note.—In 1929 each series was divided into two equal longitudinal sections designated as Sections A and B respectively. The plots in *Section A* are being continued under the original plan of fertilization. In *Section B* additional fertilization is as follows: potassium chlorid to all plots, 100 pounds an acre drilled with wheat and 50 pounds hill-dropped for corn; superphosphate (20 percent) to Plots 1 and 10, 250 pounds an acre drilled for wheat and applied broadcast for corn; sodium nitrate to Plot 10 at the acre-rate of 166 pounds in the spring as a top dressing for wheat and 83 pounds as a side dressing for corn at time of second cultivation.

TABLE 57.—TOLEDO FIELD

Rotation: Corn, oats, mixed hay, wheat

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
				SECTION A				
							lbs.	
1	RL, KCl	(1.13)	5.8	28.1	....	15.1	811	1.480
2	MrP, KCl	(1.49)	13.4	32.8	(1.09)	31.4	1 246	2.274
3	MLbP, KCl	(2.06)	19.8	52.5	(1.78)	34.3	1 714	3.128
4	MLrP, KCl	(1.94)	20.4	48.8	(1.60)	35.4	1 650	3.011
5	RsP, KCl	(.46)	2.9	26.2	....	11.2	559	1.519
6	RrP, KCl	(.75)	5.4	29.3	....	12.2	692	1.880
7	RLsP, KCl	(1.58)	6.4	41.7	....	30.6	1 265	3.438
8	MLrP, KCl	(1.76)	8.9	43.0	....	34.2	1 382	3.755
9	RLrPK, KCl	(2.07)	9.6	47.9	....	34.0	1 516	4.120
10	RLrP, KCl	(1.61)	5.1	33.6	....	26.2	1 122	3.410
				SECTION B				
1	RL	(1.17)	10.8	31.0	....	14.1	870	1.588
2	MrP	(1.17)	12.8	35.0	(1.02)	18.9	1 034	1.887
3	MLbP	(2.41)	17.2	50.0	(1.66)	24.1	1 631	2.976
4	MLrP	(2.29)	14.3	43.3	(1.52)	20.6	1 461	2.666
5	RsP	(.51)	5.1	20.7	....	7.1	473	1.285
6	RrP	(.75)	5.1	21.6	....	7.3	546	1.484
7	RLsP	(1.62)	16.6	29.0	....	18.7	1 047	2.845
8	RLrP	(1.71)	15.9	29.4	....	18.0	1 062	2.885
9	RLrPK	(2.20)	6.4	44.5	....	30.4	1 449	3.938
10	RLrP	(1.24)	8.2	35.3	....	15.0	931	2.830
				SECTION C				
1	0	(.52)	4.1	25.8	(.90)	5.1	548	1.000
2	M	(.81)	10.5	35.1	(1.08)	6.0	780	1.423
3	ML	(1.59)	17.5	49.1	(1.82)	21.6	1 396	2.529
4	MLrP	(2.33)	19.1	47.6	(1.53)	19.9	1 538	2.807
5	0	(.30)	9.0	18.0	....	3.4	368	1.000
6	R	(.42)	6.4	21.8	....	2.7	418	1.136
7	RL	(1.12)	15.9	34.0	....	14.4	922	2.505
8	RLrP	(1.30)	17.8	28.6	....	20.1	968	2.630
9	RLrPK	(2.02)	4.8	44.1	....	30.4	1 391	3.780
10	0	(.02)	5.4	22.1	....	3.9	329	1.000

(Table 57 is concluded on page 88)

TABLE 57.—TOLEDO FIELD, *Concluded*

Serial plot No.	Soil treatment	Series 100 Mixed hay	Series 200 Oats	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Digestible nutrients per acre, average all crops	Response index
	SECTION D							
							lbs.	
1	R, KCl	(.69)	6.4	33.5	....	6.6	663	1.210
2	M, KCl	(1.04)	16.3	34.2	(1.12)	10.5	916	1.672
3	ML, KCl	(1.98)	26.1	48.2	(1.67)	27.2	1 591	2.903
4	MLrP, KCl	(2.16)	26.1	50.7	(1.72)	34.7	1 757	3.206
5	RL, complete fertilizer	(1.29)	14.3	25.6	....	18.9	916	2.489
6	R, straw	(.56)	11.5	22.6	....	5.1	519	1.410
7	RL, straw	(1.40)	17.2	39.2	....	17.0	1 089	2.959
8	RLrP, straw	(1.67)	19.1	39.6	....	23.1	1 245	3.383
9	RLrPK, straw	(2.25)	13.4	48.3	....	30.4	1 543	4.193
10	RL	(1.33)	13.4	32.1	....	12.2	913	2.775

Note.—In order to make more detailed studies of the response of this soil type to different methods of fertilization, each series was divided in 1930 into four equal strips extending east and west across all plots. Beginning at the north these strips are designated as *Sections A*, *B*, *C*, and *D* respectively.

On *Sections B* and *C* the soil treatment continues unchanged.

Section A receives the same soil treatment as *B* plus KCl at the rate of 100 pounds an acre broadcast ahead of wheat and corn.

Section D receives the same soil treatment as C with additional fertilization as follows: crop residues to Plots 1, 5, and 10; wheat and oat straw returned to Plots 6, 7, 8, and 9; limestone (as needed to grow clovers) to Plots 5 and 10; KCl to Plots 1, 2, 3, and 4, 100 pounds an acre broadcast ahead of wheat and corn; complete fertilizer (5–15–5), 200 pounds an acre to Plot 5 broadcast ahead of wheat and corn.

TABLE 58.—TOLEDO FIELD, Corn, soybeans, oats, wheat

Serial plot No.	Soil treatment	Series 500 Soybeans	Series 600 Corn	Series 700 Wheat	Series 800 Oats	Digestible nutrients per acre, average all crops
						lbs.
1	RLrP, wheat and oats straw	22.8	41.5	23.0	14.8	1 152
2	RLrP, KCl	23.4	47.6	28.6	13.4	1 288
3	RLrP	25.7	32.5	32.0	14.6	1 200
4	RLrP, wheat straw	21.2	38.1	32.2	13.7	1 195

Note.—Prior to 1923 these series were under the supervision of the division of Soil Physics and received a uniform treatment of residues, limestone, and rock phosphate. In 1923 the series were replotted, the new plots extending across the original plots. From 1923 to 1930 inclusive the series were used in crop-variety investigations.

In 1931 a rotation of corn, soybeans, oats (Hubam clover), and wheat (sweet clover) was undertaken. The soil treatment is noted in the above table. Limestone and rock phosphate are to be residual, KCl to be applied at the rate of 100 pounds per acre broadcast ahead of wheat and corn. Residues are to consist of cornstalks, soybean straw, and green manure on all plots. In addition, wheat straw is to be returned to Plots 1 and 4 at threshing time, and oats straw is to be spread back on Plot 1 as a top dressing for the ensuing wheat crop.

TABLE 59.—UNIONVILLE FIELD
Rotation: Corn, soybeans, oats, wheat

Serial plot No.	Soil treatment	Series 100 Oats	Series 200 Soybeans	Series 300 Corn	Series 300 Stover	Series 400 Wheat	Series 400 Stubble clover (Lespedeza)	Digestible nutrients per acre, average all crops	Response index
	WEST HALF								
								lbs.	
1	0	.8	(.56)	17.2	(.33)	4.0	(.45)	492	1.000
2	M	1.5	(1.20)	32.2	(.82)	8.0	(.52)	889	1.807
3	ML	3.0	(1.92)	48.6	(1.15)	15.8	(1.08)	1 481	3.010
4	MLrP	3.1	(1.96)	47.8	(1.73)	17.8	(1.02)	1 519	3.087
5	0	1.0	7.7	10.7	....	5.7	....	305	1.000
6	R	1.2	10.5	15.2	....	6.2	....	403	1.354
7	RL	2.5	14.3	42.2	....	13.8	....	858	2.812
8	RLrP	2.8	14.8	50.7	....	17.7	....	1 009	3.308
9	RLrPK	3.6	16.3	58.1	....	20.2	....	1 148	3.764
10	0	1.7	(.70)	12.8	....	9.0	....	408	1.000
	EAST HALF								
1	L	.3	(1.20)	31.6	(.66)	4.5	(.59)	842	1.711
2	MLrP	1.7	(1.89)	53.6	(1.24)	14.5	(.93)	1 475	2.998
3	ML, KCl	4.6	(1.92)	55.5	(1.57)	15.8	(.88)	1 539	3.128
4	MLrP, KCl	4.9	(2.17)	55.5	(1.76)	17.5	(1.19)	1 700	3.455
5	LsP	1.0	(1.73)	30.9	(.80)	10.3	....	878	2.879
6	L, $NaNO_3$	1.2	(1.50)	28.2	(.77)	7.3	....	763	2.502
7	RLsP, KCl	3.8	11.7	52.9	....	19.3	....	1 014	3.325
8	RLrP, KCl	3.8	14.3	63.2	....	19.7	....	1 171	3.839
9	RLrP, kainit	4.6	16.8	53.3	....	20.5	....	1 111	3.643
10	LsP, $NaNO_3$	1.7	(1.67)	35.8	(.91)	14.7	....	983	2.409

TABLE 60.—UNIONVILLE FIELD
Rotation: Wheat, cowpeas, timothy

Serial plot No.	Soil treatment[1]	Series 500 Wheat	Series 700 Timothy	Series 800 Cowpeas Seed	Series 800 Cowpeas Straw	Digestible nutrients per acre, average all crops	Response index[2]
						lbs.	
1	0	6.3	(.29)	5.2	(.68)	394	1.000
2	MLrP	18.0	(1.68)	8.8	(1.94)	1 310	2.712
3	RLrP	16.9	(1.29)	7.0	(1.69)	1 094	2.265
4	RLrP, kainit	18.7	(1.59)	9.1	(2.20)	1 342	2.778
5	RLrP, shale	15.3	(1.48)	7.2	(1.76)	1 145	2.371
6	RLrP, common salt	15.6	(1.40)	8.0	(1.83)	1 149	2.380
7	RLrP, Omaha K	16.7	(1.31)	7.3	(1.54)	1 076	2.228
8	0	4.7	(.68)	6.8	(.98)	573	1.000

[1]Manure residual since 1927. [2]The average of Plots 1 and 8 is the check for all treated plots.

TABLE 61.—URBANA, MORROW PLOTS
Rotation Studies

Section of plot	Soil treatment	Plot 3 (Continuous corn) Corn	Plot 4 (Corn and oats rotation) Corn	Plot 5 (Corn, oats, clover rotation) Soybeans[1]
NW	0	4.1	10.0	(1.29)
SW	MLrP	29.3	30.2	(2.41)
NE	0	11.6	6.7	(1.94)
SE	MLbP	26.4	24.7	(2.18)

[1]Clover failed and soybeans were grown as a substitute crop.

TABLE 62.—URBANA, SOUTH FARM
Southwest rotation: Corn, oats, clover, wheat

Serial plot No.	Soil treatment	Series 100 Oats	Series 200 Soybeans	Series 300 Wheat	Series 400 Corn	Series 400 Stover	Digestible nutrients per acre, average all crops	Response index
							lbs.	
68–SW	RrP	37.6	(2.29)	39.1	41.9	....	1 630	1.106
69–NW	R	34.0	(2.10)	32.6	40.3	....	1 474	1.000
70–SW	M	45.6	(2.27)	35.8	52.2	(1.20)	1 806	1.000
71–NW	MrP	47.9	(2.40)	37.9	53.2	(1.30)	1 888	1.045
68–SE	RLrP	42.8	(2.57)	26.8	53.6	....	1 701	1.233
69–NE	R	34.4	(2.36)	24.8	35.1	....	1 379	1.000
70–SE	M	46.4	(2.14)	29.2	45.8	(1.00)	1 623	1.000
71–NE	MLrP	49.3	(2.43)	35.0	58.6	(1.60)	1 943	1.197

TABLE 63.—URBANA, SOUTH FARM
North-Central rotation: Corn, corn, oats, clover

Serial plot No.	Soil treatment	Series 500 Second-year corn	Series 500 Stover	Series 600 Oats	Series 700 Clover	Series 800 First-year corn	Series 800 Stover	Digestible nutrients per acre, average all crops	Response index
								lbs.	
48–S	RrP	16.5	....	65.4	(2.29)	44.2	....	1 653	1.154
49–N	R	15.4	....	65.2	(1.58)	42.5	....	1 432	1.000
50–S	M	33.0	(.85)	68.8	(2.12)	39.4	(.94)	1 847	1.000
51–N	MrP	38.2	(.95)	66.8	(2.17)	44.3	(.90)	1 954	1.058

TABLE 64.—URBANA, SOUTH FARM
South-Central rotation: Corn, corn, corn, soybeans

Serial plot No.	Soil treatment	Series 500[1]		Series 600		Series 700	Series 800[1]		Digestible nutrients per acre, average all crops	Response index
		Second-year corn	Stover	Third-year corn	Stover	Soybeans	First-year corn	Stover		
									lbs.	
68–S	RrP	17.5	....	43.0	....	31.8	37.3	....	1 553	1.018
69–N	R	16.6	....	41.9	....	31.6	37.0	....	1 525	1.000
70–S	M	26.3	(.50)	54.1	(1.00)	(2.42)	36.4	(.70)	1 927	1.000
71–N	MrP	27.9	(.42)	50.6	(1.05)	(2.08)	38.3	(.70)	1 853	.962

[1]A heavy infestation of chinch bugs caused the yields to be very irregular.

TABLE 65.—WEST SALEM FIELD
Rotation: Corn, oats, wheat, mixed hay, wheat

Serial plot No.	Soil treatment	Series 100 Soybeans[2]	Series 200 Wheat	Series 300 Oats	Series 400		Series 500 Wheat	Digestible nutrients per acre, average all crops	Response index[3]
					Corn	Stover			
								lbs.	
1	0	(.45)	.5	6.1	13.2	(.55)	1.2	260	1.000
2	ML[1]	(.82)	16.2	23.1	44.6	(1.17)	16.2	999	3.842
3	ML	(.65)	19.5	30.0	59.4	(1.78)	21.1	1 237	4.758
4	MLrP	(.95)	26.7	34.4	63.4	(2.12)	24.8	1 461	5.619
5	L[1]	(.71)	3.0	11.2	23.7	....	11.3	519	2.181[3]
6	RL[1]	(.89)	6.2	14.2	34.2	....	12.2	696	2.924[3]
7	RL	(.83)	15.2	22.8	39.0	....	16.9	916	3.849[3]
8	RLrP	(.90)	24.7	21.7	32.3	....	21.8	984	4.134[3]
9	RLrPK	(1.32)	29.2	30.2	67.9	....	27.0	1 505	6.324[3]

[1]Initial application of limestone only. [2]Soybeans grown as a substitute for mixed hay. [3]The check for the residues plots is the digestible nutrients of Plot 1 less the stover value, or 238 pounds of digestible nutrients.

INDEX TO FERTILIZER AND TREATMENT MATERIALS

MINERAL FERTILIZERS

10,000—5-34—5647